THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW

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THE FIRST BRAKE REPORT.

AT last our patience is rewarded by the issue of the Report of a Special Committee of the Tramways and Light Railways Association on Tramcar Brakes. Extracts from it we print on another page, but no one who is interested in the subject should be content with such a necessarily extreme condensation, but should refer to the Report itself, which is nothing less than a text-book, and is well worth the price at which it is sold. The volume is one of over 100 pages, well printed, in clear type, on good paper; and it may be said to embody the essential experience of our foremost tramway men, edited and inspired by such authorities as Messrs. Sayers, Fell, Worby Beaumont, A. N. Connett, and A. H. Pott.

The special services rendered by Mr. Fell well merit the generous reference of the Committee to one of its own members, for many pages of curves and tables testify to the labours of Mr. Fell and of his assistants. To him and to Mr. Sayers our modern tramcar brake literature is mainly due, and we can trace their influence in every page of the Report.

We regret deeply that there is another report to come from another Committee, for we can only suppose that there is some radical difference in the recommendations of the two Committees, as they were unable to agree to issue the fruits of their labours as the voice of one mouth. We recorded the fact in a recent issue, and know nothing of the nature of the disagreement, for disagreement we must suppose it to be, but we shall be reflecting the opinion of the public in saying that we looked for a good sturdy chicken after all this hatching; a bird which would command universal respect because it was undisputed cock of the walk. We very much fear, however, that we shall see the deplorable spectacle of two rival claimants of the post of public mentor, which must lead to the *dicta* of both being weakened.

We find it difficult to believe that two Committees, composed, on the face of them, of sensible men eminent in their own spheres, could not find a greater common denominator, by the use of judicious elimination and assimilation, which would permit of the production of a "one and all" report, stronger by far than two unwelded, and, perhaps, unweldable proclamations of opinion. Just as we do not know the nature of the two Committees' differences, so we are not aware whether one is more to be blamed than the other, but we cannot help thinking that the old antipathy between private and public enterprise, which has done so much in the past to keep back the development of tramways, and to weaken the defensive and creative powers of the whole tramway interest, is to be seen cropping out again.

Of course, it was deliberately organising a great waste of energy to appoint two Committees in the first place, as the goal of each was common and their paths identical; but

that initial disregard of the best interests of the community might have been atoned for in great measure by an ultimate union of forces, from which would have been produced the unassailable opinion of the tramway world.

The report before us opens with a valuable and ably-written treatise on the theoretical requirements of brakes, which enables us to judge for ourselves the absolute usefulness of any particular form or method of braking. The Committee considers that the problems of braking should be classified under four heads, as follows:—(1) Service; (2) Coasting; (3) Avoidance of collision with any object; (4) Runaway stops; and each of these conditions receives separate treatment; but we are inclined to think that an identical purpose would have been served had the classification been confined to two heads, and those simply: (1) Service, and (2) Emergency stops. It is the idea of the Committee to have cars which run on anything but a flat and lightly loaded line, equipped with a brake which is capable of use either for service or for the maximum possible effect such as is required in any emergency, and with another form of brake which can be used for coasting only.

It is shown clearly, to our mind, in the report, that no form of brake is, or can be, invented which will provide certainly against those accidents which are characterised by absence of notice. A retardation of 7 ft. per second per second is almost beyond the practical limit, yet this is not nearly high enough to prevent the car running over a child who has darted across the track out of an entry, or to avoid collision with a dray which pulls across the line when the car-driver expects that it will remain clear until he has passed. Perhaps, therefore, it was somewhat unnecessary to complicate the real issue by sub-dividing emergency braking conditions, although we agree that they are divisible, for we cannot find that any different form of brake is recommended for the two cases, nor, of course, are two forms necessary.

The same kind of objections can be raised to the separation of normal braking into service stops and coasting, although here the Committee does recommend the use of a special coasting brake; a brake, in other words, which will neutralise the acceleration due to gravity upon a downward running car, but will not be quick enough for service or emergency use, or, perhaps, powerful enough to hold the car on a heavy grade.

The Committee, in fact, holds that there should be two brakes on every car, an opinion with which we are in entire agreement, but we cannot go farther with it in wishing to have one of these for both service and emergency use, and the other just a coasting brake. We do not think that we are misinterpreting the intentions of the Committee, and we should be extremely sorry to do so in the least degree.

It would give us great pleasure to be able to endorse every line of this most valuable report, but we cannot bring ourselves into line on this most vital matter of the functions of the two brakes, and we will put the reasons to our readers once more in the form of a concrete case.

The Committee's car, equipped with a power brake "which will give a powerful and easily moderated force for ordinary service stops, and can apply, when necessary for emergency stops, a force equal to half the car weight instantaneously and continuously to slipper blocks" (*vide* General Conclusions), and with some form of comparatively slowly applied brake for coasting, is descending a hill with a grade of 10 per cent. and a curve at the foot. The driver has made his B. of T. stop at the top of the hill, and has applied his coasting brake before restarting. By means of this brake, and an occasional touch of the power brake, the dangerous slope is being negotiated with smoothness and safety. Just at the worst point, the coasting brake fails, and the car accelerates with terror-striking rapidity, but the emergency is met almost as soon as it arises by the instantaneous application of the power brake, aided by a supply of good sand, and—the Committee's opinions are vindicated. Let us now reconstruct our example in the light of our own knowledge, expressed in the words of the report: "Of the 15 serious accidents reported upon by the B. of T., blame is directly imputed in nine cases to the driver of the car, and in the remaining six accidents a better knowledge on the part of the driver might have averted the accident. No amount of training will prevent accidents which are caused by sheer negligence or carelessness . . . . In two of the accidents reported, it is distinctly stated that the driver was considered to be experienced."

One of these human drivers is in charge of the car and is about to descend the hill. He is behind time, or he is making the last trip at night, and he has a good notion of the whereabouts of the nearest inspector, so he does not stop at the brow of the hill, and he proceeds to apply the coasting brake on the way down, as, regardless of the B. of T., he has done often before. This time, unfortunately, he is a trifle too casual, or the rails are exceptionally greasy, and, before he can annul the acceleration due to gravity, the said gravity has the car running at 15 M.P.H., when, pull as he may, the driver cannot do anything effective with the coasting brake. Giving it up, after merely succeeding in taking weight off the other brake, he throws the power brake on to the full extent, and it fails to act. Perhaps the motors flash over or some mechanical breakage occurs. Nothing now can avert disaster, and in due course the coroner sits on a corpse or two, the doctors are busy in the hospital, and the B. of T. reports that the brakes were in good order, but were used improperly.

We have no use for the coasting brake as such, and maintain that the two brakes should each be capable of stopping the car under all circumstances short of their own failure. In fact, we see nothing in the report which can modify, but a good deal which strengthens, our opinion that the most satisfactory safety equipment will consist of an electro-magneto-mechanical service brake and an entirely independent and positive emergency brake. The former must be capable of retarding the car up to the limit suggested by the Committee, and even beyond it, as it may be impossible at times to prevent a terrible catastrophe except at the cost of a few broken bones and bleeding noses. The latter is to be brought into use only when the service brake has failed, and is to be of such a type that total failure is almost unthinkable. Its power, of course, must be as great as it is possible to obtain, and must be applied fully and finally by one simple movement requiring no more thought or strength than to pull the trigger of a gun.

The Committee recognises the importance of sanding in relation to effective braking in all weathers and conditions of rail, and in addition to examining, describing and criticising every form of brake at present used in Great Britain, it performs the same services in connection with all known sanders.

It recognises also, and alludes to, the need for a clean rail, but we take the liberty of thinking that greater prominence should have been given to something which we may fairly look upon as being almost as essential for effective braking as the brakes themselves. It is not every tramway which can afford a special water car equipped with scraping and brushing appliances, although we are convinced that such a car soon pays for itself anywhere, as it can be utilised for general locomotive work and for snow ploughing when not

engaged in its proper duties; but every line can afford at least one or two sets of track cleaners, of which there are several kinds of more or less excellence.

If a manager has no faith in these appliances, he should see at least that the work which they are said to do is done in some other manner, and in the last resort he should have the rails on all the hills which might produce an accident cleaned and sanded by manual labour, not merely weekly or daily, but constantly enough to keep them clean always.

Given perfect brakes, perfect sanders and clean rails, we are still short of the perfect man to use them, and we congratulate the Committee upon the inclusion of a section in its report dealing with the training of drivers. Special attention is directed to the necessity for initial and quinquennial medical inspections, and for full training in driving and in a knowledge of the complete equipment under the driver's control.

It is thought necessary also to re-examine drivers annually with regard to training, but this may not appeal to everyone in the same way.

The Committee was taking its courage in both hands in recommending that double-decked cars, especially those with top covers, should not be used on narrow-gauge lines having severe gradients and sharp curves, and it may seem strange to some that this advice should come from a Committee which has been trying to find the best way to protect these cars from the chance of accident by undue speed. Nevertheless, we agree that double-decked cars are used in some towns where we should feel safer inside the cars than on their top decks, but the fact remains that, of the 15 fatal accidents reported, seven were concerned with cars of standard gauge, and one with a car of 4 ft. gauge, so that by this criterion the Committee's recommendation should not be confined to narrow-gauge cars.

Great as the objections to such a course may be, we wish the Committee could have seen its way to conclude its very learned, able, and practical report by focusing the whole of its acquired experience and obvious impartiality upon one solid simple clause in which two forms of brake, and two only, should be named as the best for every car under every condition. As matters stand at present in the "General Conclusions" of the Committee, the individual manager is left with a good deal of scope for individuality, which is really the very thing which the Committee was required to suppress. It does not exist on our steam railways, and it should be banished from our tramways.

Let it not be thought that we are advocating the extinction of the inventor of braking devices, or that we wished to have the Brakes Committee suggesting that Messrs. Brown's slipper brake, and Mr. Robinson's wheel brake, should be used upon all cars in future. Our use of the phrase "forms of brake" should make such a misunderstanding impossible.

The Metallic-Filament Lamp and the Price of Energy.

The advent of the new type of lamp should be welcomed as a boon by the electric supply industry. Any improvement which cheapens the electric light to the consumer must increase the demand and redound to the advantage of those who supply it.

There is no question as to the general effect of the new form of burner in materially reducing the amount of electrical power required per candle-power of light, and the natural effect upon the supply companies is a loss of revenue from customers who have changed over to the improved lamp. It is, in fact, a temporary check to the volume of business, but does not afford an adequate reason for increasing the price to the consumer.

The improved conditions only affect the question of lighting, which is rapidly becoming subordinate to the requirements for power, traction, and heating; by cheapening the cost of illumination the use of electricity will be made more general, and the business of supply will make more rapid progress. The reduction of the lighting peak will improve the load factor, and set free plant otherwise earmarked for the winter maximum.

There is no doubt as to the extent of the saving resulting from the use of the metallic-filament lamps; we have some typical examples before us, furnished by the engineer of a suburban electric lighting company. The cases selected are those of three important shops, the accounts for the March quarter in 1907 with carbon lamps being compared with those for the corresponding period in 1908 with "Osram" lamps:—

	1907. Carbon lamps.	1908. Osram lamps.	Saving.
Provision dealers ...	£13 8 2	£6 14 3	£6 13 11
Grocery stores ...	£9 9 6	£4 14 10	£4 14 8
Drapers	£8 1 6	£4 7 8	£3 13 10

Besides the actual saving in the cost of lighting, it is pointed out that there was a substantial increase in the candle-power, which still further emphasises the economy obtained. Under the old conditions it was found to be advantageous to adopt electricity in place of gas or other illuminants, so that it is obvious that with such a substantial reduction in the cost of electric lighting the facts have only to be known to bring on to the mains a much larger proportion of the residents.

One drawback is the present high price of the metallic-filament lamps; but this will, no doubt, be modified as the arrangements for more extensive manufacture are carried out, resulting in cheaper cost of production.

The carbon lamp when first introduced was sold at 15s. each, and now much better qualities can be had for 1s.; and so it will no doubt be in the near future, that the metallic lamp will be sold at a price much lower than at present. There are already several manufacturers producing them in competition, so that monopoly prices are not likely to prevail; indeed, reductions are already being announced.

One result of the introduction of the metallic-filament lamp was pointed out at the annual meeting of Messrs. Drake and Gorham, Ltd., who are specialists in country house lighting. Mr. Drake remarked that by the use of these lamps the working cost of the electric light was reduced to about 2d. per 1,000 C.P.-hours. The plant required for supplying the same amount of light being much smaller than is necessary with the carbon lamp, there is an important saving in the installation also.

The reduction in the revenue due to the metallic-filament lamps alarms the managing engineers of supply stations, some of whom have suggested raising prices to meet the altered conditions; a little reflection will prevent such a false step, and they will see in the greatly reduced cost to the consumer an ultimate advantage to the lighting business. There could not be a stronger weapon in fighting the gas companies than the important reduction in the cost of electric lighting shown in the figures we have given above.

It was often shown before this change took place, that lighting by electricity was more economical than gas, apart altogether from the indirect advantages arising from its being (to quote a well-known series of pamphlets) the "healthiest, safest, steadiest, cleanest, most pleasant, most beautiful and most convenient means of obtaining illumination;" but with a reduction in cost of energy by one-half, coupled with an increase of 50 per cent. in candle-power, all other systems, whether gas, oil or tallow, are simply "out of it."

If the public were made thoroughly acquainted with the facts, very few residents upon the line of mains would be without a supply, and the increase of business would rapidly overtake any loss by the reduced consumption from the more efficient lamps.

Taxation in Germany.

The electrical companies in Germany are threatened with fresh taxation of a double character, and they intend to evade one of the imposts—in the event of its being introduced. In the first place, there is the projected tax on the consump-

tion of electricity and on the use of lamps and arc light carbons; and secondly, there is the proposed additional taxation of limited companies. The former is an imperial scheme, whilst the latter is intended solely for Prussia. It would be impossible to escape the electricity tax if it were brought into operation, but the company tax in Prussia could be eluded by the migration of the companies to other parts of Germany, and this action will probably take place, in case the Prussian Diet should adopt the proposals of the Government. The directors of the Transmarine Electricity Co., which is specially interested in electrical undertakings in Buenos Ayres, have already announced that if the Bill becomes law the domicile of the company will be removed to one of the Hansa cities; and the Electric Light and Power Investment Co. has resolved to follow the example by transfer to a city outside Prussia, and also to disestablish its subsidiary companies. The latter, under the circumstances, would be dissolved and their assets entirely absorbed by the parent company, which already holds most of the share capital issued by them. It is expected that other undertakings will adopt a similar policy, especially trust companies; and if this should prove to be the case, many companies will be domiciled in States other than Prussia. The Prussian Minister of Finance recently stated that the suggestion of migration was only a threat, and he instanced similar statements of projected transfers on the conclusion of the new Customs tariff two or three years ago. But things have changed since that time. The period of high prosperity has passed, and electrical companies may be expected to strive to avoid the new company tax, if they are unable to liberate themselves or their customers from the consequences of the electricity tax.

Cheap Telegrams.

Despite the inherent and obvious absurdities of the proposal to establish a penny-a-word tariff for telegrams throughout the Empire, the agitation still persists, and is even supported by persons who ought to know better. Some of the latter, however, show a disposition towards moderation, and may be able, by restraining the impetuosity of their friends, to secure some good results from the current movement.

Mr. Lemieux, for example, the P.M.G. of Canada, while advocating cheap cabling, has declared that he would be satisfied with an all-red cable, and a substantial reduction in the existing cable rates. Sir Joseph Ward, P.M.G. (and Prime Minister) of New Zealand, has avowed his approval of the proposal, but does not anticipate the introduction of a penny-a-word rate for some time to come. But Sir Edward Sassoon, Chairman of the Telegraphs Committee of the House of Commons, is organising a meeting in the City to support the penny movement. Surely he is aware of the utter impracticability of the scheme? We cordially approve of the extension of the all-red system and the cheapening of the means of communication throughout the Empire; but we can only characterise the universal penny movement as a wild-cat scheme, without the remotest prospect of realisation.

Electricity in Cotton Mills.

In the article by Mr. W. H. Booth, which is concluded in the present issue, the electrical driving of cotton mills is viewed from the standpoint of the Lancashire engineer, whose affection for the low-speed engine, rope drive, and shell boilers is proverbial. We have always deprecated precipitate action in the application of new methods, and there is no doubt that much harm has been done to electrical driving in textile mills by the use of unsuitable systems and apparatus. We believe, however, that Mr. Booth greatly underrates the advantages to be derived from electrical power, supplied from an external source, and that there is a magnificent field open for development in this connection, of which the cultivation has, in fact, already commenced.

COST AND CONSTRUCTION OF OVERHEAD WORK.

By E. GOOLDING, A.M.I.M.E., A.M.I.E.E.

In the preparation of reports and estimates connected with tramway schemes it is not always possible, when dealing with the cost and construction of overhead work, to obtain the amount of detail necessary for drawing up a full schedule of quantities and prices.

If, on the other hand, details are obtainable, it often happens that time is limited, so that it is impossible to work out the cost in detail.

Under these conditions an approximate estimate has to be given, but the means of arriving at the approximation is not always satisfactory, owing to the want of data. The object of this article is to present a table of costs to facilitate the ready estimating for overhead work.

Bearing in mind the many conditions upon which depends the cost of this work, it is to be hoped that the following table will only be considered as a means of obtaining a close figure for the erection of overhead work. In the preparation of this table the costs of a number of different schemes have been assembled, and by comparing the various costs and conditions the following summary has been made.

In the practical work of construction special conditions are to be met with on every scheme, involving some additional expenditure, and as each item affects the actual cost of the work, it is obviously impossible to embody all the special conditions that arise in carrying out work of this nature; should structural difficulties arise, such as low railway arches, swing bridges, alterations to property, or serious underground obstructions, such as pipes, sewers, shifting sand, rock, &c., a covering figure must be added.

Before actually dealing with the cost of overhead equipment, perhaps it would be as well to consider first some of the leading features of overhead construction.

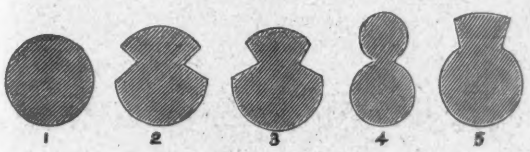
The class of work and method of construction depend mainly upon individual ideas, the tendency being to lean towards the elaborate and expensive construction, which construction is often at variance with the local surroundings in which the work is situated. When selecting designs it is natural to centre one's attention upon the object under consideration, but it is questionable whether too much importance is not often attached to the appearance of the individual pole, to the detriment of the general effect of the work when completed. For instance, take a road 45 ft. wide from kerb to kerb, having track centres 9 ft. from kerbs, with trees on each side of the road: what class of overhead construction would appear best under these conditions?

In a case of this sort it is invariably the appearance of the road which has to be considered, and the main thing is to avoid anything unsightly, so the best arrangement that presents itself is obtained by placing short bracket-arms on either side, the poles being set back and hidden by the trees.

Supposing the tracks are some distance from the kerb, the use of a long bracket-arm to take the double track looks obtrusive, in which case span wire construction is to be preferred. Then, again, should the road be 50 ft. wide with tracks in the middle, the centre pole construction is generally adopted on account of appearance and cost. It is, of course, a great deal better to spread the tracks out, so that they run close to the kerb, and to make use of short bracket-arms, and thereby obtain a clear space in the middle of the road. A point to be remembered when designing this class of construction is that, with a 16-ft. trolley boom, the most practical side-reach must be at its maximum, say, 8 ft. from the centre of the track: so that, should the centre of the track be 15 ft. from the kerb, the trolley wire will be supported on bracket-arms only 7 ft. from the kerb. In narrow streets with high houses, overhead work has a tendency to look heavy and somewhat oppressive; it is, therefore, important that the lightest class of work should be adopted, for it will be readily understood that heavy poles, large bases, and elaborate scroll-work cramped in a comparatively small area are far too massive, and, combined with the dull appearance natural to overhead work, give anything but a bright aspect to a street. Constructional

work in the open country has to be as simple as possible, if capital expenditure and upkeep are of importance. The use of bases in towns is necessary for appearance, and for protection from the attentions of the canine species; but for work carried out in the open country, the best and simplest method is to carry up the concrete (in which the pole is planted) 18 in. above the ground. This gives a certain finish, and is an excellent protection from dampness. To save expense, the erection of the feeder pillar can be modified by having suitable boxes clamped to the pole, and all scroll-work or ornamentation can be dispensed with.

The question of running two trolley wires on single track depends to a certain extent on the length and class of the line, but it seldom happens that the conditions are unfavourable for the use of two wires, and where single wires have



Sections of Trolley Wire.

been erected, it is invariably a source of regret that two wires were not installed. The great advantages of two wires are:—

1. No switch-points at loops and turn-outs, consequently less wear and tear.
2. Larger conducting area of copper, which reduces cost of feeders.
3. A fault on one wire does not hold up traffic.

Before referring to the table of cost for the equipment of overhead work under various conditions, it might be as well to mention one or two points which generally arise when considering overhead work, such as bonding poles to track, to comply with the Board of Trade requirements. Only every fifth pole over which telephone wires pass has to be bonded to the track with 1 sq. in. section copper bond, but no conditions are put down with regard to bonding the intermediate poles, or bonding poles, where there are no aerial wires; under these latter conditions the poles are not usually earthed to track. This question of earthing all poles was partly discussed in a paper read before the Institution of Electrical Engineers in May, 1906, and the troubles due to live poles and corresponding dangers were then spoken of, but no conclusion was arrived at as to the advisability of earthing all poles. The practice of only bonding every fifth pole where aerial wires cross the trolley wire, and not bonding any other poles, may be all very well in places free from overhead telephone wires, &c., such as suburbs and semi-country places, but in congested towns and cities, where extensions and alterations to aerial conductors are constantly taking place, it would be a very expensive matter to break the road, lay earth wires, and reinstate the road and path every time a new wire was suspended over the track. Then again, the paving in busy thoroughfares is usually such that it effectively keeps the subsoil in a dry condition, and a live pole becomes a matter of considerable danger. It is therefore best, in view of these considerations, to earth every pole when the track is being constructed. This has been found the most satisfactory way of dealing with the matter on several large undertakings. The cost is not more than £25 per mile, the outlay being little more than it would cost to lay the earth wire to one pole after the road had once been made.

In the following schedule of prices for city work it has been assumed that all poles are earthed to track, but for work carried out in the country it is not considered necessary to earth poles, and no allowance has been included in the cost given.

Trolley Wires and Fittings.—It is generally admitted that grooved trolley wire with mechanical ears is an improvement on the round wire with soldered ears; in selecting a design, the two important considerations are easy running and the life of the wire, as they naturally bear the most prominent part in the ultimate cost of upkeep. A number of sections are shown above. Sec. 3 was selected for the Burton and Ashby lines, and is also being largely used on other lines, because it presents three distinct advantages:—

1. Good hold for mechanical ears.
2. Large wearing surface.
3. Smooth running for trolley wheel.
4. Ease of erection.

This section has been adopted on different lines, and is now being used for lines under construction; it has in all cases given excellent results. It is therefore a point of importance when considering new work to embody the most improved form of conductor now in use.

Sectional steel poles are universally adopted for supporting trolley wires on the span-wire or bracket-arm system, and the three standard sizes to choose from were introduced by the Standards Committee as follows:—

—	Length.	Approx. weight.	Outside diameter of sections.			Used for
			Bottom.	Middle.	Top.	
Heavy.	31 ft.	1,130	7½	8½	9½	Supporting curves and anch. ring.
Medium.	31 ft.	860	6½	7½	8½	Span wire, big spans and double trolley wires, 16-ft. bracket arms with double trolley wires.
Light.	31 ft.	670	5½	6½	7½	Span wires, short spans and single wires and short bracket arms.

The rake given to the poles is entirely a matter of judgment, and is ruled by the conditions of the work. The actual whip, or bend of pole, is seldom much more than 3 or 4 inches under working strain, but the rake given to a pole for span wire construction may be from 6 to 12 inches, and in the case of anchor poles, 12 to 20 inches. This rake is due to the give at the base, which can be observed when pull is put on the pole, and therefore has to be allowed for in the rake of the pole. With bracket-arm construction the strain on the poles is in a different direction, and as a rule it is found sufficient to give 3 in. or 4 in. rake on a straight line, so as to counteract the weight of bracket arm and trolley wire.

Cost of Overhead Equipment.

1st Class.—Includes the supply and erection of poles, bases, collars, finials, cross-arms and scroll work, trolley wire and mechanical fittings, guard wires, earthing all poles, two feeder pillars and leads to section insulators; includes also special work for three curves and one junction, and poles painted and numbered.

2nd Class.—The same as above, with the following exceptions:—Small pole bases, strap, cross-arms, less scroll work, no guard wires, and the feeder poles only earthed.

3rd Class.—Will be the simplest possible construction. There will be no bases or collars, and straps instead of cross-arms, no scroll-work, and only feeder poles earthed. No guard wires are included, and allowance is made only for one curve and one junction; otherwise the fittings and feeder pillars are the same as the 1st Class equipment.

Overhead Equipment.—Cost per Mile.

Class of construction.	Double trolley wire, 0·000 s.w.g.					Single trolley wire, 0·000 s.w.g.				
	City.	Town.		Country.		City.	Town.		Country. 00 s.w.g.	
	Class of work.					Class of work.				
	1st	1st	2nd	2nd	3rd	1st	1st	2nd	2nd	3rd
	£	£	£	£	£	£	£	£	£	£
Span wire ..	1,600	1,450	1,200	1,200	1,100	1,430	1,300	1,050	1,000	950 *750
Bracket ..	1,300	1,200	1,000	1,020	900	1,100	1,000	910	870	780 *650
Centre pole	1,400	1,300	1,000	950	850	—	—	—	—	—

* Use of wooden poles.

Note.—The above figures do not include track bonding, cable ducts, or feeders, but include all material and fittings complete for running in accordance with the class of work specified.

E

Cost of Bonding.

Cost of bonding during construction of track work. Two bonds per joint, including one junction and three crossovers.	Double track.		Single track.	
	City.	Country.	City.	Country.
	240	180	120	90

Two 0000 s.w.g. solid bonds per joint, and cross-bonding every 100 yds. between track rails and two inside rails of double track.

In addition to these figures for overhead work, there is often, as previously mentioned, some special difficulty to be contended with, and heavy expense is often incurred in overcoming the same; and should structural difficulties be apparent, an additional sum must be included. In the case of city work, as much as 10 per cent. may have to be added.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Direct Supply.

Will you kindly permit us, through the medium of your valuable columns, to again draw attention to an old but still continued scandal. We received a letter yesterday from a customer of ours, in which the following paragraph occurs:—"I do not think it will be necessary to trouble you for the fittings, as I can obtain these direct from the ——— ——— Co. at a better discount than 10 per cent." It is, of course, well known to contractors that private individuals nowadays will not purchase fittings at list prices (which state of affairs has, of course, been brought about by the manufacturers allowing private individuals discount), and we are, therefore, in the habit of quoting usually 10 per cent. off manufacturers' catalogues to try and get the order for fittings, but it is now practically impossible to get an order even with this discount given off list prices.

We believe that various contractors' associations have been formed with the main object of trying to do away with this sort of thing; but, in spite of this, it seems to be rather on the increase than the decrease.

Windsor and District Electrical Co.
T. Bridgen, *Manager.*

Windsor, *November 11th*, 1908.

Branches v. Agencies.

As a branch manager, I do not think that "Vilex's" first letter should go altogether unchallenged, for it is not a fair statement of actual facts.

Taking the personal aspect which comes early in his letter, I should say that any branch manager who cannot deal with the largest contracts should either resign or insist on being given full information by his works.

My personal position is, that I can, and often do, design and suggest what my works should do in all sorts of work, and I am not conceited enough to think that I am alone in that respect.

In using a branch as a store or not, "Vilex" should know that, under the present condition of trade in this country, the holding of stocks in the biggest industrial centres is inevitable. If a branch cannot arrange the greater part of its stock so that it is turned over as often as the stock at works, then that branch wants reorganising.

Regarding the position of affairs between branch managers and their respective works, "Vilex's" statements are true to a large extent; but, given the unscrupulous manufacturer, an agent's position is often no better.

I am entirely at one with "Vilex" in his statement about the English method of paying as little as possible, but 50 years of Free Trade are largely responsible for this.

"Vilex's" question, "Are branches cheaper than agencies?" is very like a counsel's request for a "Yes" or "No" answer to a question in a legal case, when the questioner knows full well that a simple answer cannot adequately cover the point.

Agencies must be cheaper than branches; but does "Vilex" imagine for a moment that an agent, whose superficial knowledge has to cover four or five different classes of technicalities, is going to do half, or even a quarter, the business that one practically technical commercial engineer will do in any one of the classes? It is on this score that "Vilex's" comparative figures, as to the cost of the agency and what the branch should cost, are misleading.

I may say that I would just as soon be an agent instead of a branch manager, provided the total remuneration was the same; but as a branch manager, fully equipped with commercial and technical experience, and backed by a firm who properly study their market and are willing to take tips, I would undertake a sales total six times that of an agent.

After all, American conditions are not so very extremely different to those over here, for the position of the American wholesale factor should be analogous to the branches over here. If this be not so, then I say that the fault is not with the branches, but with those who establish them and those who run them.

With reference to "Vilex's" second letter, I just think that all directors and proprietors of electrical manufacturing concerns are not quite as lacking in appreciation of business principles as he suggests, and I can assure him that had his figures been as reliable as his letters are interesting, he would not have had to wait so long for my reply.

Euclid carefully explains step by step the most self-evident propositions; but can "Vilex" think that his letters even properly set out the terms of a none too simple business proposition?

London Manager.

What is an Electrical Engineer?

May I be allowed a brief comment on "Engine-Driver's" letter in your current issue? He speaks of avoiding the series-connecting of metal lamps by running a mid-wire to the centre of his battery, and I wish—as a battery engineer, and in thorough sympathy with the treatment the poor things get—to point out that this is not the full solution of the problem.

He will find that the lamp-hours on the two halves will rarely be equal, and that in consequence one half gets fully charged before the other; he must therefore either cut this half out entirely, or over-charge it and wear out the positive plates with excessive gassing in order to bring the heavily-loaded side full again. An alternative would be to provide a change-over switch, so as to exchange the groups of lamps from one side to the other, which would allow each side to be charged fully on alternate days. This would be a better solution than persistent over-charging of the lightly-loaded half; but the only correct method would be to arrange to charge each half independently, according to its discharge.

Mem.

November 16th, 1908.

The Selection of Turbo-Alternators.

I have read a letter in this week's Electrical Review from Mr. J. H. Thomas, in which he mentions that, in the discussion on Dr. Kloss's paper before the Manchester Section of the I.E.E., I stated that the question of voltage regulation is generally kept well in the background. I would like to point out that I did not express myself in these terms, but stated that designers, as a rule, prefer to guarantee voltage rises rather than voltage drops, since the latter, on paper, are liable to be thought excessive. Generally speaking, in turbo-alternators any desired regulation can be guaranteed, provided the customer is prepared to pay for the same.

Mr. Thomas states in his letter that none of the gentlemen who discussed this paper referred to the "Tirrill" regulator, or such devices. I would point out, however, that I specially mentioned this question, and described in detail Messrs. Parsons's method of alternator compounding. The advantages of this arrangement over types of regulator which depend on electric relays and opening and closing circuits

are fairly obvious, and have been much appreciated by engineers who have the apparatus in every-day use; while close guarantees for voltage rise or voltage drop, even with heavily inductive loads, can safely be given.

Alex. H. Law.

Newcastle-on-Tyne, *November* 16*th*, 1908.

Which is the Rational Method of Stoking?

The assertion that underfeeding is new is altogether incorrect, and due to ignorance of what has been done in the past. Many hundreds, if not thousands, of underfeed stokers were put in and largely used some 25 years ago, but the proper overfeeding system showed so much better results, producing without smoke much more steam at a less cost, that the underfeed was discarded.

If steam users will consider the two methods of firing, they will find it easy to reach a conclusion entirely in favour of the overfeed system as applied in the modern method of blowing the air into a self-cleaning fire bar, whence it issues under pressure into the fire by small streams, well disseminated over the grate.

The coal is fed on to the top of the fire in exceedingly small quantities, thereby inducing an intense heat which drives out the gases, causing them to mix with the air immediately over the fire, so that combustion is completed in the least possible space and in the shortest time.

The underfeed system, on the contrary, has to be supplemented by expensive fans to force the air through the thick and sluggish fire produced by this system. In addition to this, there is the further disadvantage that the grate surface is narrowed, as it was in the old English underfeed stoker, by the space in which the coal is pushed up into the fire.

The additional pressure of air which the underfeed stokers are bound to employ in their furnace to keep the fire alight at all, is liable to blow through between the stoker front and the boiler plate, an eventuality that would considerably injure the boiler and rivets.

In the paragraph in which the question "Which is the rational method of stoking?" (see advertisement, page 40, November 13th) is asked, a diagram of a very ancient system of hand-firing is shown, in which the coal is piled up in the centre of the furnace, thinning towards the sides; whereas in modern overfeed systems the coal is spread evenly over the fire, and each square foot of fire is doing its own full work and evaporation. The flame on a modern high-temperature "Bennis" overfeed stoker completes its combustion within a few feet of the ends of the bars. The flame on underfeed stokers, on the contrary, whether of the old or new type, often reaches the end of the boiler before combustion is complete. The conclusion is obvious to any engineer.

Radix.

November 16*th*, 1908.

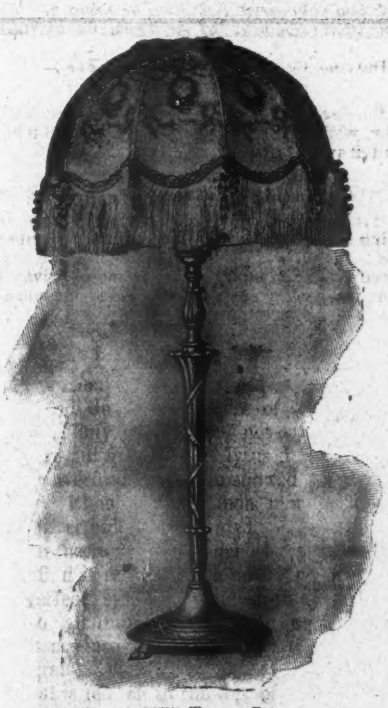
[We presume that when our correspondent alludes to the underfeed stoker being discarded, he alludes to those that were put on the market some 25 years ago. In regard to the concluding paragraphs, can "Radix" produce any evidence to show that in the "underfeed" stoker now advertised, the flame "often reaches the end of the boiler before combustion is complete"?—Eds. E.R.]

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

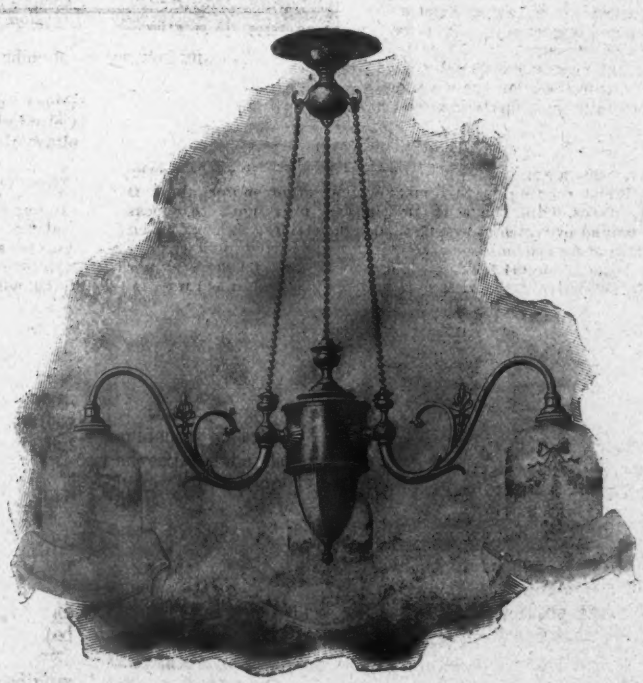
New Electrical Fittings.

Last week, Mr. G. Braulik opened new showrooms at 8, Lambeth Hill, Queen Victoria Street, E.C., where he is displaying a larger assortment of electric light fittings, and to better advantage, than is possible at his Upper Thames Street premises. The newpremises extend down Lambeth Hill to, and are connected with, the rear of the old offices.

The showroom is an extensive one, well suited to the effective display of the different styles of electroliers, brackets, standards, bronzes, and so on that the firm supplies. One section of the room is partitioned off for showing chiefly candle-fittings in French styles, and there are a number of neat examples of brackets and electroliers, two-light counterweight fittings, &c. On a counter round the window sides of the rooms are placed various table standards, bronzes, and small manufactures, while convector and lamp radiators, and floor standards are also on view for the convenience of the trade. In the accompanying illustrations we show one of Mr. Braulik's three-light Adams pendant fittings, in satin-brass and frosted-silver finish, also a Louis XVI table lamp in gilt and frosted-silver.



Louis XVI Table Lamp.



Three-Light Adams Pendant.

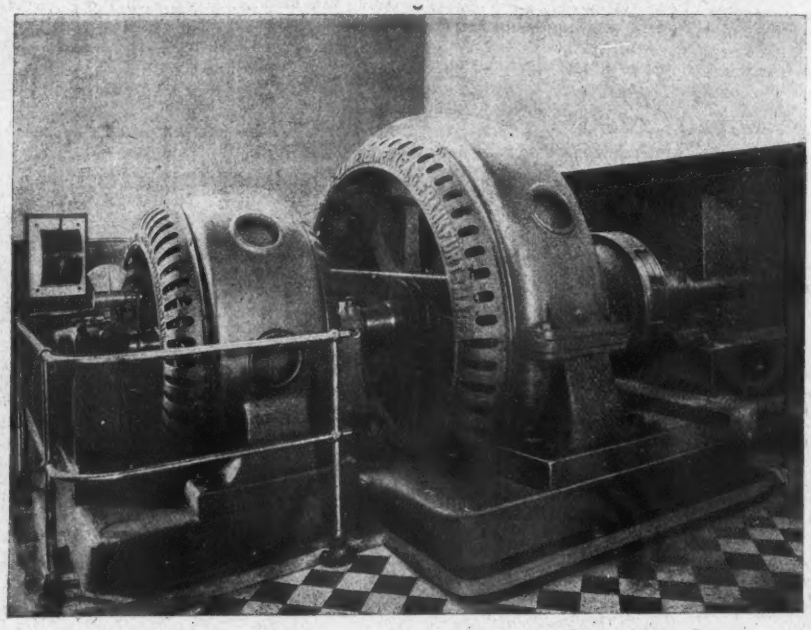
Cascade-Connected Mine Ventilator Motors.

Mine ventilators have frequently to be provided with some means by which their output may be varied. For instance, when opening up a new mine, the quantity of air to be dealt with will increase as the workings progress, and the ventilator should be capable of being speeded up, in order that its capacity may be

increased in the most efficient manner. Should the ventilator be driven electrically, therefore, means should be provided for regulating the speed of the motor, and if three-phase current is employed, as is now customary in mining work, the cascade connection forms a convenient method of meeting this necessity. As is now well known, the cascade connection consists of taking current from the rotor of an ordinary induction motor and feeding it into the stator of a second motor, whose rotor is short-circuited in the usual way. The two machines are mechanically coupled to one another, and the speed of the combination is determined by the frequency of the supply and the number of poles of the two motors. If F is the frequency, and p_1 and p_2 the number of pairs of poles of the main and auxiliary motors respectively, the speed in R.P.M. will be—

$$n = \frac{60 \times F}{p_1 + p_2}.$$

The Felten and Guilleaume-Lahmeyerwerke A.-G., of Frankfort, have recently delivered a cascade set for driving a ventilator at the Mont-Cenis Colliery, Solingen, Westphalia. The ventilator is of the Rateau type, and was supplied by Messrs Schüchtermann & Kraemer, of Dortmund. It is designed for a normal output of 6,000 cb. m. (211,800 cb. ft.) of air per minute, with an equivalent pit section of 2·25 sq m. The diameter of its impeller wheel is 3·4 m. The main motor, of the slip-ring type, is fitted with a short-circuiting and brush-raising gear, for use when the auxiliary motor is not in use, and has a continuous output of 600 H.P. at 2,000 volts. The smaller motor has a short-circuited rotor, and its stator is wound with two independent windings having four and eight poles respectively. The frequency of the supply is 50 cycles.



Cascade-Connected Motors for Driving Colliery Ventilating Fan.

The larger motor has 20 poles, and when running as an ordinary induction motor with short-circuited rotor, its speed is—

$$\frac{60 \times 50}{10} = 300,$$

or about 294 R.P.M. at full load, when allowance is made for the slip. When running in this manner the larger motor alone is under current, while the auxiliary machine runs light. Air-locks are provided by which the equivalent pit section may be adjusted to 2, 2·25 or 2·45 sq. m. The corresponding outputs of the ventilator when running at 294 R.P.M. are 5,350, 6,050 and 6,500 cb. m. per minute respectively, the motor delivering 450, 495 and 540 H.P.

When the four-pole winding of the auxiliary motor is connected in cascade with the main motor, the speed of the set is—

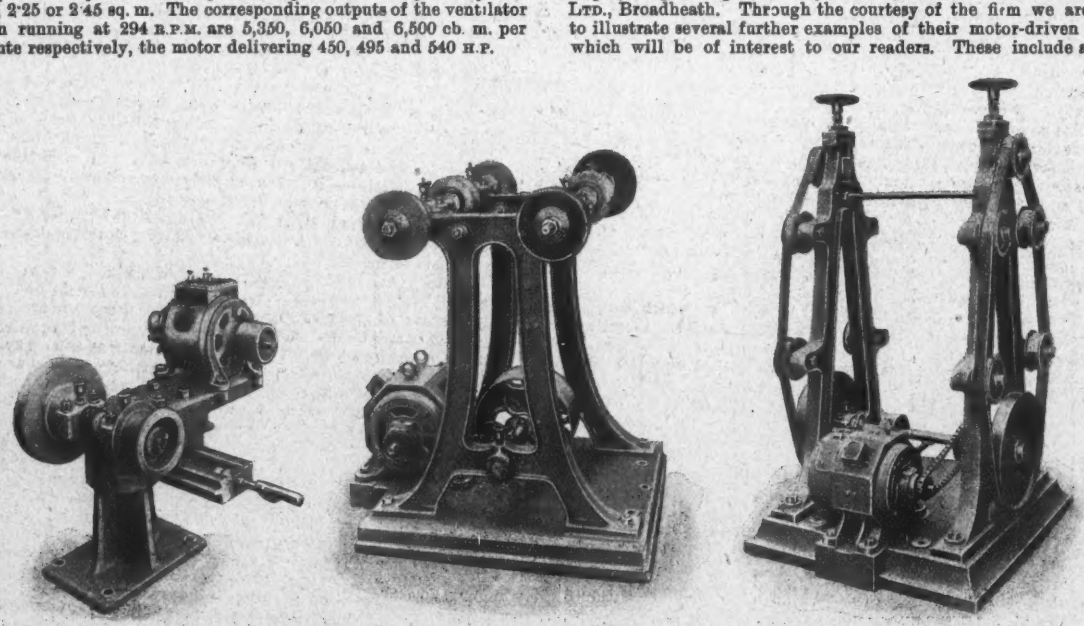
$$\frac{60 \times 50}{10 + 2} = 250 \text{ R.P.M.}$$

With the openings as mentioned above, and at this speed, the ventilator displaces 4,400, 5,000 or 5,400 cb. m. of air per minute, the corresponding motor outputs being 260, 290 and 315 H.P. In the last case, the motor output of 315 H.P. comprises 257 H.P. converted into mechanical energy by the main motor, and 58 H.P. developed by the auxiliary machine. The voltage delivered to the latter is about 101, at a frequency of approximately 9·2 cycles per second.

By connecting the eight-pole winding of the smaller motor in cascade with the main machine a speed of 214 R.P.M. is attained. The three outputs of the ventilator, according to the air-lock openings, are then 3,750, 4,250 and 4,450 cb. m. per minute, and the motors produce 160, 176 and 190 H.P. respectively. With the highest output the larger motor delivers 132 H.P. directly as mechanical energy, while the smaller again develops 58 H.P., at a voltage of about 172 and a frequency of 15.

Electrically Driving Grinding and Polishing Machinery.

In our recent Manchester Exhibition issues we referred to the display of grinding machinery made by Messrs. Luke & Spencer, Ltd., Broadheath. Through the courtesy of the firm we are able to illustrate several further examples of their motor-driven tools, which will be of interest to our readers. These include a commutator grinder, consisting of a cast-iron pedestal for bolting to the bed of the machine, which carries a compound slide rest with a swivelling arrangement for bringing the grinding wheel into position. A 10 in. dia. × 1½ in. emery wheel is mounted on the spindle, which is held in adjustable bearings. The device, as shown in our view, has an extended arm carrying a 1-B.H.P. 230-volt D.C. motor and starter; it is suitable for trueing up commutators 6½ in. wide × 13½ in. diameter.



Commutator Grinder. Double Brass-Finishing and Polishing Machine. Double Emery Band-Polisher.
Luke & Spencer's Motor-Driven Machinery.

A double brass finishing and polishing machine, consisting of two horizontal shafts, supported in standards and carrying at their four extremities two 8-in. dia. emery wheels, one 8-in. dia. buffing or polishing wheel, and one 10-in. dia. bristle brush. This machine can be provided with special wheels, buffs, &c., or the spindle ends can be arranged to take small emery rollers for internal work, and such appliances can be easily changed, owing to each wheel being held by one nut only. Our illustration shows clearly the 1 B.H.P. motor mounted on the base, and the driving arrangements.

An improved double emery band-polishing machine is also illustrated, the two polishing bands being carried on pulleys outside the two standards, and driven by a 1-B.H.P. motor, fixed to the base. This machine is specially designed for polishing irregular shapes in brass and other metal goods, such as cocks, bends and mouldings; also for polishing shovel straps, engine parts, grates, stoves, &c.

BRAKING ARRANGEMENTS AND SANDING-GEAR ON TRAMCARS.

ABSTRACT OF THE REPORT OF THE SPECIAL COMMITTEE APPOINTED BY THE TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

Introductory.—The Committee thought it desirable to divide the work between two sub-Committees. The references were as follows:—

Sub-Committee No. I.—To recapitulate and discuss the general objects to be aimed at to obtain braking effects, and the physical laws which govern them.

Sub-Committee No. II.—(*a*) The classification of the various forms of brakes. (*b*) Recommendations as to the best forms of brakes for various conditions. (*c*) Recommendations as to the class of blocks for use with wheel and track brakes; and (*d*) recommendations as to the most suitable form of sanding gear.

The Council accepted the offer of Mr. Fell to carry out tests on coefficients of friction. Mr. Fell has also furnished a large number of brake tests, and the Committee cannot too strongly express their indebtedness to him for the trouble he has taken and the freedom with which he has placed his results at their disposal.

Theoretical Requirements of Brakes.—The braking of tramcars has to be effected under different conditions, which may be classified as follows:—(1) Service stops; (2) coasting; (3) stops to avoid accidents from collisions of all sorts; (4) runaway stops.

The runaway condition is a result of the failure of the appliances intended to effect purpose No. 2, and is confined to gradients, whilst the emergency stop to avoid collision may be required at maximum speed at any part of the route, and is characterised by the absence of notice.

Service Stops.—The more frequent the stops, the more important it is that they shall be made in the smallest practicable time. The practical limit of retardation is determined by the comfort and safety of the passengers.

The same consideration applies to acceleration in starting, and it is generally admitted that 3 ft. per second^2 is about the upper limit for comfort. With this rate each stop will take very nearly 2 seconds per mile per hour of the initial speed. This assumes that the rate is constant, which is not generally true.

Coasting.—The control of speed on falling grades requires a braking effect which shall neutralise the accelerating effect of gravity. It should be applied, therefore, throughout the whole length of any gradient of which the slope and length is such as to produce a dangerous speed in an unbraked car.

The practicable limit of speed is that at which the service brake will certainly stop the car within reasonable distance—say, 30 to 40 ft.

It may be reckoned that a moving car will accelerate by gravity on any descent upon which the fall exceeds 1 per cent. of the track length, and that a stationary car, unbraked, will be started upon any descent on which fall exceeds 1·3 per cent., say 1 in 70.

The gravity acceleration in feet per sec.^{2} due to any gradient, is the product of 32·2 into the fraction or percentage expressing the fall as a ratio of the track length, or of 22 M.P.H. per second into the same fraction or percentage. But, as the rail resistance on a straight clean rail is of the order of 1 per cent. of the car's weight, 0·32 ft. per second, or 0·22 M.P.H. per second, should be deducted from the acceleration so found.

If the gradient thus defined is expressed as a fraction, *e.g.*, 1 in 8, as $\frac{1}{8}$, or, as a percentage, *e.g.*, 1 in 8, as 12½ per cent., then the acceleration force due to gravity action upon a vehicle is the same fraction or percentage of its whole weight, and may be conveniently called the gradient fraction or percentage.

For braking purposes, and for most of the effects involving safety, the square of the speed has to be considered. Hence, a car running at 10 miles per hour has only half the kinetic energy that it has when running at 14·14 miles per hour, and so on. The tendency to overturn at curves by centrifugal force and the tendency to derail under given conditions of radius and super-elevation are also proportional to the square of the speed. It follows that a gradient which will accelerate a car from rest to 20 miles per hour is twice as dangerous, potentially, as one which will accelerate it to 14·14 miles per hour.

For various limiting safe speeds the maximum allowable falls are deduced as follows:—

Maximum fall.					Acquired speeds.
1·2 ft. plus 1 per cent. of gradient's length				=	6 M.P.H.
2·13	"	"	"	=	8 "
3·3	"	"	"	=	10 "
4·8	"	"	"	=	12 "
7·5	"	"	"	=	15 "
13·2	"	"	"	=	20 "

The danger of a gradient cannot be taken as simply proportional to the fall along it, for, at least, two important reasons:—

First, the time rate at which the speed increases is a very important factor, and is simply proportional to the slope, so that of two gradients with the same total fall, the less steep may be quite safe, because a car will not accelerate upon it to a dangerous degree between service stops, or without giving the driver ample time to keep it under control, whilst the steeper may be much less safe, because a momentary negligence or mistake of the driver will result in a serious increment of speed; and, secondly, the braking or retarding force required to annul the gravity acceleration is equal to the weight of the car multiplied by the effective gradient fraction or percentage, and only the balance is available for stopping; thus, in the above example of a gradient of 1 in 12, or 83 per cent., the effective accelerating gradient is 7·3 per cent. = 164 lb. per ton, or 7·3 × ·322 = 2·36 ft. per second^2. So that, i controlled by brakes having a total retarding force of 4 ft. per second^2, the balance available for stopping would be only 1·64 ft per second^2.

A further consideration is that the safe limit of speed falls as the gradient becomes steeper, because braking power diminishes with speed, from the diminished coefficient of friction.

From all these considerations, it follows that the control of speed on severe gradients requires the use of a brake which will neutralise the gravity acceleration and keep the speed down to a point at which the car is well under stopping control; that, as this takes up a calculable brake power, it can be specially provided, and should be in such a form as to leave the whole service brake power available for stopping; that the safe speed for descending gradients is inversely as their steepness, and should be so regulated that the improved coefficient of friction due to lower speed is utilised to neutralise the effect of the gradient; that loss of braking power due to other causes, *e.g.*, greasy rails, must be specially guarded against upon severe gradients.

Emergency stops are stops to avoid accidents from collision with other vehicles, pedestrians or obstacles. In streets carrying heavy traffic, or on a dark road at night, the avoidance of collision may be a question of a few inches or a fraction of a second, and the driver may have no time to spare. It is, therefore, of the utmost importance that his action shall be automatic or instinctive, unembarrassed or delayed by the conscious choice between various brakes. As he is constantly using his service brake, it, therefore, seems that this brake should be of such power that it can be relied upon to give the maximum retardation practicable. For such use, the limit is the safety of the passengers and the car. A retardation of 7 ft. per second^2 will certainly throw down standing passengers and will put unduly severe stresses upon the car body, especia y if carrying an upper deck load and cover.

From a given speed the stopping time and distance are each inversely as the available retardation, but from different speeds with the same retardation, whilst the stopping time is proportional to the initial speed, the distance is proportional to the square of the speed, and as distance is the criterion rather than time, it follows that the braking power should be increased as the square of the maximum running speed.

Mean retardations above 9 ft. per second^2 are hardly practicable, *e.g.*, 50 ft. is about the minimum practicable stopping distance from a speed of 20 M.P.H.

As the available coefficient of friction diminishes with the increase of speed, constant retardation demands the greatest application of braking pressure at the highest speed. Also the time taken to get the brakes on after the necessity is apparent to the driver, is evidently of the greatest importance at the highest speed. Both considerations show that as speeds increase, it becomes the more imperative to have a brake available which (*a*) is operated by the driver instinctively; (*b*) is put on by a single motion, as instantaneous as possible; (*c*) is put on with the maximum pressure at first; and (*d*) gives the maximum retardation tolerable.

Runaway Stops.—To provide means of bringing under control a runaway car which has attained a dangerous speed, is a most difficult problem. Under some circumstances it may be impossible. The condition of excessive speed indicates that the usual brakes have failed, been misapplied, or neglected, so that, besides the physical difficulty, there is every probability of the driver being in a nervous, panicky, or bewildered condition, unable to think clearly, or make the best use of his resources.

The gradient diminishes the stopping power of the brakes provided, and greasy rails and high speed diminish the coefficient of friction, so that the gravity acceleration due to the slope may be in excess of the total braking power available after the car has attained a certain speed. For example, on a wet rail the coefficient of friction at 10 M.P.H. may be about ·15, and at 20 M.P.H., only ·11. Then, if half the weight of the car is available for braking, the total retarding force at 10 M.P.H. will be, ·5 × ·15 = ·075 of the weight, which is equal to the gravity acceleration on a grade of 8½ per cent., so that on such a gradient the car is beyond control at a speed of 10 M.P.H.

At a speed of 20 M.P.H. control will be lost on a grade of 6½ per

cent. (say, 1 in 15½). It follows that, if the critical speed has been reached the only possible means of restoring control involves either the utilisation of a greater fraction of the car's weight, or an increase in the coefficient of friction.

Skidded wheels almost always form one of the conditions, and these nullify all brakes depending upon the motors. Even if the wheels are revolving, the motor E.M.F. may be so much above the normal that attempts to use them may fail owing to flashing over on the commutators.

It has been asserted that a skid, fitting the rail groove only, experiences a much higher coefficient of friction than any block applied to the rail table, and it is proposed to fit such skids concentric with the wheels, so that upon releasing them they fall under the wheels, which mount them, and the skids then act as extremely efficient track brakes. The coefficient of friction of any material in the form of a groove skid is the same as if used on the rail table, but the skid is wedged into the groove, and the pressure between the skid and the sides of the groove is greater than the force pressing the skid into the groove in the ratio $\frac{\theta}{2}:1$, where θ is the inclination of the sides of the groove.

If 9 ft. per second^2 is taken as the maximum practical retardation, a car travelling at 20 M.P.H. will require nearly 50 ft., and one travelling at 40 M.P.H nearly 200 ft., to be brought to a standstill.

The moral evidently is that runaways must be prevented, since the safe stopping of a runaway car cannot be certainly secured.

Runaways sometimes occur in the backward direction. The electrical run-back brake, which is applied when the controller handle is in the off position, has the advantage of coming into action on the driver's usual first movement, and it will only allow the car to creep down. An important aid to checking backward runaways is the provision of a sanding pedal for the rear wheels on the driver's platform, so that he may have the use of sand to assist the brakes.

On all lines having severe gradients there should be some form of track brake, but on a backward runaway the track brake will be "off" at the commencement, and, if manually applied, may not be got on soon enough to be of much value, therefore some quicker means of application is desirable to provide against accident from this cause.

General.—The type of car used on lines with severe gradients has an important bearing on the danger involved in a runaway, and also upon the brake equipment. Cars for such lines should have a low centre of gravity, and on any cars exceeding 10 tons loaded, power brakes should be used.

Available means of Braking.—Braking is subjected to, and limited by, the laws of friction between surfaces. If two bodies are pressed together with a certain force, the pull required to just cause the commencement of sliding is a definite fraction of the pressure between the surfaces, known as the coefficient of static friction. Within wide limits the value of this coefficient is independent of the specific pressure.

After sliding has begun, the pull required to maintain the movement at a uniform rate is less than that needed to start it, and is found to decrease as the speed increases. The pull needed to maintain the movement at any given speed is a definite fraction of the pressure between the surfaces, and is known as the coefficient of sliding friction.

Braking on the wheels is the oldest, simplest, and most usual method. The gearing of the wheels to the rails is not positive, but frictional, and the coefficient of friction which applies is that of static friction between the wheel and rail.

The strength of the gearing is equivalent to the weight of the vehicle multiplied by the coefficient of static friction, which in this connection is termed the adhesion. If a force be applied to the wheels in excess of this gearing strength, the wheels must slip. Now the friction between wheel and brake block is of the sliding order, to which a lower coefficient applies, and one which varies with the speed. The pressure of the brake blocks on the wheels may, therefore, exceed the weight of the vehicle, but the product of that pressure into the particular value of the coefficient must not exceed the product of the adhesion into the weight of the vehicle. Hence, the maximum braking force that can be exerted through the wheels is that corresponding to their adhesion. For clean, dry rails the maximum value of the coefficient is generally taken at 0·25, hence the maximum force available for acceleration or retardation is one-fourth of the weight on the driving or braked wheels. If all wheels are braked, this is one-fourth of the weight of the car, and the theoretical maximum acceleration or deceleration force available is one-fourth that of gravity, or 8·025 ft. per second.^{2}

When braking pressure is proportional to the weight of the car, the amount of that weight has no effect upon the deceleration available, so that a loaded car and an empty one will be stopped from equal speeds in equal spaces and times.

From the theoretical figure above, large deductions have to be made to obtain a practical figure, on account of the departure of the rail surface from a clean and dry condition. It is never safe to reckon on a higher coefficient of adhesion than 0·15.

Experience shows that for long grades, about 1 in 10 is as steep a slope as can be reliably worked in this climate by adhesion, or, in other words, that an adhesion coefficient of about 10 per cent., or 224 lb. per ton, is the lower limit. Hence it may be said that a braking force of the same amount may be always depended upon from the wheels.

The usual motive power for wheel brakes is the muscle of the driver, and it is found that a pull of about 100 lb. can be relied on. The leverage in general use is 100 : 1, so that a pressure of 10,000 lb. may be put on. The coefficient of sliding friction may be taken as about ·25, giving a retarding force of 2,500 lb.

If wheel brakes are required to give a much heavier pressure than this, then some form of power application becomes necessary.

Wheel braking is also practised by electrical methods, including the regenerative, rheostatic, and run-back brakes; and combined with magnetic track brakes in at least two different ways. Retardation thus obtained is limited by the adhesion. Such brakes cannot skid the wheels for any length of time, and they call for almost no exertion on the part of the driver. They are all put out of action if the wheels are skidded by another brake.

On services where wheel brake retardation is sufficient, the wheel-block and rheostatic brakes may be used alternately, but the rheostatic brake should be used before, not after, the hand brake.

The electrical run-back brake is a very simple, effective and cheap device, which should be fitted to every car working on gradients of 1 in 70 and steeper.

Neither the rheostatic nor run-back brakes can be depended on to check a car that has attained a runaway speed upon a falling gradient.

Regenerative control furnishes a method of braking analogous to rheostatic braking, but with a definite speed limitation.

The principal advantages of track or slipper brakes are that their effect is not limited by the wheel adhesion.

The special value of mechanically applied track brakes is for the control of speed on severe gradients. The correct procedure is to put the brakes on before starting down, and to make any necessary stops and starts with the hand-brakes. Manually applied, they are too slow and laborious to be used for either service or emergency stops, but with power application they give as rapid and powerful braking as can be got from the use of the car's weight.

Magnetic track brakes produce two distinct braking effects, one due to the drag of the magnetised blocks upon the rails, the other on the wheels, due to the brake action of the motor; but, as the magnet poles are necessarily of iron or steel, the coefficient is lower than with wooden blocks. The maximum attraction possible is about 150 lb. per sq. in. of polar surface, and, as the practicable size of the blocks gives a polar surface of 30 sq. in., each block may exercise a pull of about 4,500 lb.

The connection of the magnetised blocks to the wheel blocks, so that they can be put on by the drag of the magnets, is a further combination which permits of the whole of the available wheel braking force being brought into play by the magnetic brake alone, part through the motors, and part through the brake blocks.

The importance of clean rails has been sufficiently shown by abundant experience. Rail brushing and scraping are worth doing in many cases, and specially-equipped watering cars, with brushes and scrapers following a forced water jet are the most effective. The attachment of brushes and scrapers to service cars is of more doubtful value.

Sanding is an important auxiliary to braking, and should be in the sole control of the driver. The sanding gears in common use are fairly certain in action, but the direction of the sand is nearly always faulty. The delivery of 10 times as much sand as can be effective is the usual thing.

Any device which puts sand certainly under the wheel tread will give the driver a confidence which is now frequently lacking.

Sanding for the rear wheels may be important in run-backs, and on hilly lines. Both sets of sand boxes should be worked from each platform.

Comparative Coefficient of Friction Tests.—As very little data were available, it was thought desirable to obtain some additional information as to the relative values of cast-iron, wrought-iron and various samples of wood for use as brake blocks. The results are given in several Appendices to the Report.

The coefficient of friction of wood on a wrought-iron wheel is considerably higher than that of cast or wrought-iron blocks, and lengthening the block from 12 in. to 18 in. has no appreciable effect. Elm has the highest coefficient of friction on a steel wheel, followed by ash, maple and oak in the order named. Tests on cast-iron blocks gave an even and regular set of curves, the coefficient holding up well as the speed increased. Wrought-iron did not behave so satisfactorily, the coefficient falling rapidly as the speed increased.

Wood blocks, tested as slipper brakes, when dry showed high coefficients, oak, poplar and ash varying from 0·5 to 0·6, with elm and maple slightly lower. Cast-iron blocks, 18 in. long, gave very low results, but they differed so much from other tests that they must be accepted with reserve. Both C.I. and W.I. 12-in. blocks show results considerably lower than those obtained in a previous series of experiments.

Tests were made to determine the variation in the coefficient, with oak, poplar and steel blocks under varying conditions of rail surface; the wood blocks being tested both wet and dry.

The results are in conflict with rather widely-held opinions, inasmuch as they show that the coefficient falls off on wet and greasy rails more with wooden blocks than with steel ones. They also show that with steel blocks the coefficient is higher with a wet clean rail than with a greasy one, but with wooden blocks the reverse in the case. So far as they go, these tests indicate that steel shoes maintain a higher coefficient of friction on bad rails than has been supposed. Tests with both wood and steel through a higher ranger of specific pressures corresponding to service loads, and with rails "greased" with the mud of different localities, are needed to complete our knowledge of the subject.

Information.—The undertakings, which have replied to a series of questions, work a total of 5,000 cars, and include large cities, such as London, Liverpool, Leeds, Dublin, &c., where the traffic is heavy, and systems such as Hastings, Yorkshire (Woollen), South Metropolitan, Chatham, &c., where the gradients are severe.

The following are the types of brakes fitted to the cars:—

Hand wheel brake	5,018 cars
Rheostatic brake	2,866 „
Magnetic track brake	1,278 „
Mechanical track brake	1,967 „
Electric short-circuit brake	917 „
Pneumatic track brake	121 „
Regenerative control	60 „
Run-back brake	87 „

The combination of brakes fitted is shown to be as follows:—

Hand wheel brake only	95 cars
Hand wheel and short-circuit	468 „
Hand wheel and rheostatic	1,922 „
Hand wheel and mechanical track ...	57 „
Hand wheel and magnetic track	1,424 „
Hand wheel and regenerative	23 „
Hand wheel, rheostatic and mechanical track	745 „
Hand wheel, regenerative and mechanical track	10 „
Hand wheel, regenerative and rheostatic	36 „
Hand wheel, pneumatic and short circuit	84 „
Hand wheel, pneumatic and rheostatic ...	36 „
Hand wheel, regenerative, rheostatic and mechanical track	21 „

Service Stops.—The particulars collected show that, for ordinary stops, the hand-wheel brake is generally used, except on systems working heavy bogie cars in congested traffic, where the magnetic track brake has been largely adopted as a service brake. In some cases the magnetic track brake, while fitted, is reserved for emergency work.

The rheostatic brake is used to some extent for making service stops.

Emergency Stops.—All systems, with but few exceptions, report the use of an electrical form of brake for making emergency stops.

Coasting.—The hand brake is generally used on a gradient flatter than 1 in 20, except in some cases where the magnetic track brake is fitted, and is used for this purpose. On steeper grades some form of track brake is usually fitted. When coasting on the mechanical track brake the rule appears to be to apply it before commencing the descent, the speed regulation being controlled by the hand brake.

Brake Tests.—During the past 18 months the Committee have inspected most of the later forms of braking apparatus, but it was impracticable for them to make tests on all those they examined. They have, however, obtained from members of the Committee and from others, the results of a number of valuable tests to which they attach considerable importance. These tests are given in the appendices. In examining the tests with reference to the different types of brake, we give but little consideration to the greasy rail tests, as they are very conflicting, as might be expected, on account of the vague definition of a greasy rail.

Wheel Brakes.—The limiting retarding force possible is the product of adhesion and weight. For general tramway purposes it is inadvisable to calculate on a higher coefficient than 0·25, or a higher retardation than 8 ft. per second^2. If it is a hand-brake the time of application, physical effort, and other operations which he must perform simultaneously, make it unreasonable to demand of a motorman efficient stops. If it is a power brake good results should be expected.

The effect of the condition of the rail on the possible braking effect, can be reduced within small limits by the use of sand, and to permit the braking effect through the wheels to vary by 50 per cent. by reason of the failure of the sander, is a reproach which should never be incurred. A careful examination of tests leads us to believe that the hand brake should give a retardation from 3 ft. per second^2 for a heavy double-deck car, to 3·50 ft. per second^2 for a single truck lighter car.

Slipper Brake.—The limiting retardation possible is the product of the whole weight of the car carried on the slipper shoes, and the coefficient between brake shoes and rail.

How near this limit is realisable in practice depends upon the safe proportion of the weight of the car which may be carried on the shoes and the time to apply the maximum effort.

The hand slipper brake is slow in application, and requires considerable effort, two serious disadvantages. With power application both of these disappear. The Pringle type of slipper brake can be only an emergency brake, and the same may be said of the Freund brake in the form seen by the Committee, but it is understood that a later form is designed to extend its scope to service and coasting use.

Rheostatic Brake.—This is dependent on wheel adhesion, but is independent of the varying coefficient of friction of brake shoes. The tests generally show that it is an effective brake for quick stopping. The use of sand to maintain adhesion at its higher values is a necessary adjunct to the brake. A retardation of 4 ft. per second^2 can be expected. It is open to the objection of bringing additional work on the motors.

Magnetic Track Brake.—The retardation with this brake comes from several features which differ considerably in the different types of the brakes. All have one feature, the friction of the magnetic shoes with the rail. A hand mechanical arrangement can be fitted to the British Westinghouse, the Maley, and the B.T.-H. brakes.

The coefficient of friction of the shoes is not easy to determine. Mr. Fell has assumed this at 0·22, which is the value indicated by his tests. Assuming, however, a value of 0·20, we have a retardation value of 3,200 lb. in the case of a bogie car, and 2,240 lb. for a single truck car. Taking the weights of the cars as 14·5 tons and 10·5 tons respectively, we get retardations due to the magnets alone of 3·18 ft. per second^2, and 3·06 ft. per second^2 respectively. The rheostatic brake and the wheel brake action combined should not exceed 50 per cent. of the maximum adhesion of the car wheels, for the danger of skidding must be avoided. The retardation then, through the wheels, becomes 4·0 ft. per second^2 or a total retardation of 7·18 ft. per second^2 in the first case, and 7·06 ft. per second^2 in the second case.

The magnetic brake, with or without wheel block attachment, may be fitted with a solenoid device for controlling the motor field current, thus eliminating all danger of skidding the car wheels.

We believe that the retardation with the magnetic track brake for average conditions should be taken at about 6 ft. per second^2.

That these brakes are efficient in stopping a car is certain. That they add to the work of the motors is also certain, and, further, they have the disadvantage that faults occurring in an electrical brake are not so obvious as those of a mechanical brake.

Causes of Accidents.—We have made a careful study of the causes of all fatal accidents which have occurred during the past 10 years due to cars getting out of control, and have been much impressed by the inaccuracy of the numerous newspaper and public statements which have been made declaring that these accidents were caused by defective brakes. These views are not borne out by the reports published by the Board of Trade.

It is essential that all motormen should undergo a medical examination and eyesight tests, and the Committee recommends periodical re-examination.

The tendency in the past has been to confuse the motorman by giving him too many operations to perform, and the Committee recommends that he should have as few alternative operations as possible to perform when stopping a car in any circumstances.

A large number of minor accidents occur on account of defects of mechanism. Most of these troubles might have been avoided by careful and frequent examination and overhauling. If a car is fitted with several alternative brakes, as a rule only one or two of these are used, and the brake examiners finding this to be the case, neglect to examine those infrequently used.

In many instances the car-sheds are not designed to make the work of the brake examiner as simple as it should be.

Then follows a description of all the brakes examined and tested by or for the Committee, with a statement of the advantages and disadvantages of each.

Another short section deals with the suitability of different brakes under varying conditions, which consists of a recapitulation of the previous matter; and this is followed by a section descriptive of sanding gears. This section concludes with the remarks that sand gear has not been sufficiently considered, and is open to considerable improvement.

An important chapter on the training of motormen, which includes an outline of the course adopted in the L.C.C. school for motormen, is followed by the *General Conclusions* of the Committee, which in the main are:—

1. All cars should be fitted with two brakes.
2. Where quick and frequent stops are necessary, one of these should be a power brake.
3. Where traffic is light, and the maximum speed low, both types may be applied manually, but, where steep grades exist, only one should depend on wheel adhesion. The combination of wheel and slipper brakes accompanied by a regulation for a compulsory stop for the application of slipper brakes before descent of a severe grade, meets this condition.
4. The power brake should be the service brake.
5. The power brake best suited to the general requirements is one which will give a powerful and easily moderated force for service stops, and, for emergency stops, a force equal to half the car weight instantaneously and continuously to slipper blocks.
6. Where a magnetic track brake is in use on very steep grades, an attachment for manual application is recommended.
7. One man should be responsible for the state of the brakes on every car, and a frequent and systematic examination of all brakes should be made.
8. Sanding apparatus should be reliable.
9. There should be two sand boxes on each end of the car.
10. Motormen should be examined medically on engagement, and re-examined every five years.
11. The course of training described is recommended, and motormen should be re-examined periodically.
12. On narrow-gauge lines, having severe grades and sharp curves, the use of double-decked cars, especially with top covers, is inadvisable.

The report is signed by Messrs. S. Sellon, A. L. C. Fell, W. Worby Beaumont, P. Cardew, A. N. Connett, R. J. Howley, A. H. Pott and H. M. Sayers.

The appendices occupy 67 pages.

American Publications.—The amalgamation of technical publications proceeds apace in the United States—probably partly due to the industrial depression following the crisis, the effects of which are not passing away as speedily as some had hoped. The *American Telephone Journal*, *Sound Waves*, *The Telephone Magazine*, and *The Telephone* are all amalgamated in one paper known as *Telephony*. The New York *Electrical Review* has also absorbed an old familiar exchange in the *Western Electrician*, of Chicago, and the combined publication will be *The Electrical Review and Western Electrician*.

BUSINESS NOTES.

Consular Notes.—Turkey.—The Austrian Consul at Beirut reports that in May, 1906, a concession for the construction and exploitation during 99 years of an electric tramway and lighting plant was granted by Royal decree to a native of Constantinople, who sold it for 700,000 fr. to a Belgian company. This company (Société Ottomane des Tramways et de l'Electricité de Beyreuth), with a capital of 3 600,000 fr., has its head offices in Constantinople, but is not the same as the Damascus Tramway Co. It was formed by the Franco-Belgian Syndicate, Franco-Belge de Tramways et de l'Electricité, of Brussels. The work was begun in the summer of 1907. The electric power will be produced by steam engine-driven generators. The length of the electric tramway system which the company binds itself to construct is 12 kiloms.

China.—H.M. Commercial Attaché at Pekin reports that the Chinese Imperial Telegraph lines were added to during the year 1907 by the recovery from Russia of the lines outside the reserve of the Chinese Eastern Railway in Northern Manchuria, and the length of the whole Chinese system, which was 22,419½ miles in 1906, amounted to 25,913 statute miles in 1907 with a wire length of 39,196 miles. No arrangement was arrived at for the recovery of the lines in Japanese hands in Southern Manchuria. The mileage of submarine cable—946·11 sea miles—remained the same. The number of telegraph offices was increased from 379 to 490, and the instruments in actual use numbered 888 against 768 in 1906. These lines, which are under the control of the Chinese Imperial Telegraph Administration, are exclusive of lines erected in many of the provinces, usually by administration and controlled by the provincial authorities. It is well known that the profits accruing to the administration are dependent more on royalties on foreign messages than on receipts from telegrams originating in, and transmitted throughout, the Empire.

Elsewhere in his report the Commercial Attaché states that the sum of 12,804,628 Haikwan taels, the value of the railway plant and materials imported into China from foreign countries in 1907, gives some indication of the growth of railway enterprise in China, but much of the plant and material is manufactured at the railway and other workshops in the country itself. There was a drop of nearly 10,000 tons of rails in the foreign import in 1907, as compared with 1906. This does not mean that fewer rails are being laid; it simply means that rails are being turned out and supplied by the Hanyang Iron Works at Hankow. The value of the foreign import was 7,996,325 Haikwan taels in 1903, 6,046,459 Haikwan taels in 1904, 7,346,739 Haikwan taels in 1905, and 11,439,806 Haikwan taels in 1906. Machinery and fittings to the value of 6,022,421 Haikwan taels (£978,643) were imported in 1907, against £943,099 in 1906. The 1907 import, which was 94·48 per cent. above the average of the previous five years, included machinery for cotton, flour, paper, oil, and other mills, for iron works and for arsenals and mints. The imports of telegraphic materials decreased from £92,070 in 1906, to £60,237 in 1907.

Bavaria.—The British Consul at Munich reports that the three following lines of the Bavarian State Railways will be the first to be electrified: Salzburg-Freilassing-Berchtesgaden-Konigsee (length of line, 28 miles; cost of electrification, £259,670); Garmisch-Mittenwald-Scharnitz (length of line, 15 miles; cost of electrification, £53,174); Garmisch-Griessen (length of line, 9½ miles; cost of electrification, £51,166)—a total length of line of 52½ miles, and a total cost of electrification of £364,010. The Minister of Communication states that £2,375,000 will be required for the electrification of the railway system to the south of Munich, about 350 miles in length. In order to prevent the purchase by speculators (to the pecuniary disadvantage of the State) of water-power concessions granted in the past, the Bavarian Government are now only allowing such concessions to be transferred to *bond fide* purchasers and retaining power to revoke such transfer should it have been made for speculative purposes. This is a possibly needful precaution in view of the approaching electrification of the railways, in which water-power will play a most important part. The net profits of the Munich municipal tramways amounted to £21,170 in 1906-7, which works out at £441 per mile, the system being 48 miles long. The trials of heating the Munich municipal tramcars by means of electricity were unsuccessful, on account of the expense. New trials were made during the winter of 1907-8 with small stoves fed with anthracite, placed on one side towards the middle of the car. The average temperature thus obtained within the cars amounted to 55° F.; the trials were not conclusive, and they will be continued this winter.

The net income from the Bavarian Posts, Telegraphs and Telephones amounted in 1906 to £459,100, or £122,100 more than in 1905. The first regular stations for the transmission of photographs by telegraphy, Prof. Korn's system, were established at Munich and Berlin in December, 1907. The Bavarian Postal Administration are now using a single wire for urgent telegraphic messages between Munich and Nuremberg; the apparatus, which requires five operators, transmits the message printed and ready for delivery at the receiving station. Whereas there are in Berlin 60 printing telegraph machines in use, the first of this kind in Munich was installed in a local hotel in July, 1908.

The Bavarian machinery trade having done extremely well during the 1906-7 campaign, now shows a retrograde tendency. The electrical machinery trade had to cope with an increased amount of orders, but the production being much more expensive than formerly, the profit obtained did not come up to expectation, added to which, as the Nuremberg Chamber of Commerce reports, the rate of discount during 1907 was very high. The Munich Kraus engine works showed an output of £426,000, as against £352,000 in 1906 and £276,000 in 1905. The export to the United Kingdom of Bavarian disintegrating machines was reduced in 1907. There was fair business in specialised tools and machinery, orders coming from all Germany (except Saxony), Belgium, Italy and Switzerland. Orders from Austria-Hungary—in former times one of the best markets for Munich machinery—are declining owing to the high Customs duty. The Bavarian electrical works report full employment for 1907; the deficiency of workmen complained of in other trades does not seem so apparent in this, the number of workmen employed by one important firm in Nuremberg alone having risen from 5,022 in 1905 to 6,343 in 1906 and 6,700 in 1907, and this increased number of hands was obtained without difficulty. The United Machinery Works, of Augsburg, report that their orders for the year 1907 amounted to about £3,450,000, against £3,000,000 in 1906.

The Bavarian Government have now under consideration nine important projects for obtaining water-power for industrial purposes, and for the electrification of railways. These projects represent a total of 263,900 H.P.:—

1.	River Inn	*120,000 H.P.
2.	„ Alz	†50,000 „
3.	„ Lech	‡20,000 „
4.	„ Ilz	10,000 „
5.	„ Saalach	§5,000 „
6.	„ Frankenwald	5,150 „
7.	Lake Walchensee	50,000 „
8.	„ Spitzingsee	2,000 „
9.	„ Wagingersee	1,750 „
	Total... ...	263,900 H.P

* For State Railways. † For chemical works. ‡ For Garmisch-Steinach railway. § For Salzburg-Berchtesgaden railway.

The Bavarian Government also propose to obtain a constant supply of several hundred horse-power for the electrification of the railway between Munich and Lindau, on Lake Constance, by erecting dykes and raising the level of the small mountain lake, Alpsee, near Immenstadt, by 6½ ft. To carry out this work seven farms will have to be sacrificed, and the railway embankment near the lake will have to be raised by about 5 ft. On April 1st, 1908, the Bavarian Minister of the Interior created, in view of the impending electrification of the State railways, a special department, administered by a technical staff, dealing exclusively with all questions relating to water-power. One hundred and fifty owners of water-power in Bavaria, which yields a total of 40,000 H.P., have formed an association to safeguard their various interests.

Public Meetings.—Percy F. Letts, electrician, The Arcade, Northampton.—The creditors of the above were called together last week, when a statement of affairs was submitted showing liabilities to unsecured creditors, amounting to £118. After allowing £4 for preference claims, the assets were expected to produce £86, or a deficiency of £32. The assets were as follows:—Stock in trade at cost £95, estimated to realise £47 10s.; book debts, £22 11s.; and office furniture, £20. It was stated that the debtor was previously in employment for various electrical firms. He started in business for himself about four years ago, with a capital of £30, and he had since carried out numerous contracts. No figures were given as to the turnover, but it was stated that the debtor's drawings had been very moderate. The deficiency was accounted for by the amount written off the stock, and the present position was said to be due to the bad state of trade in Northampton. Recently the debtor had a summons issued against him by one of his creditors, and he immediately consulted his solicitor. He had not previously had any proceedings taken against him. The debtor was unable to make any offer, and it was decided that the estate should be realised under a deed of assignment, with Mr. E. H. Hawkins (Messrs. Poppleton & Appleby) as trustee. The following are creditors:—

General Electric Co.	£11
Berry, Skinner & Co.	11
Berkeley, A.	12
Baxendale & Co.	53

Book Notices.—"Proceedings of the Physical Society of London." Vol. XXI, Part 2. October, 1908. London: Taylor and Francis.

"Electricity, Present and Future." By L. Poincaré. Translated by J. Kemmis. London: Sisley's, Ltd. 1908. Price 7s. 6d. net.

"Motor Manual." Eleventh edition. London: Temple Press, Ltd. 1909. Price 1s. 6d. net.

"Technology Quarterly," for September, 1908. Vol. XXI, No. 3. Boston: Massachusetts Institute of Technology."

"The Abbott Versimetric Chart." Messrs. A. Couchman, 34, Paternoster Row, E.C., send us a sample chart, No. V, consisting of a squared-paper diagram for converting from Fahrenheit to Centigrade measures and *vice versa*. Other charts convert weights, lengths, volumes, &c., there being 10 in all. Price 1s. each.

"Metric Equivalent Tables." The Central Translations Institute, 16, Eastcheap, E.C., sends us a neat folding card of conversion tables from English to metric measures, and *vice versa*, in convenient form.

"Fowler's Mechanical Engineer's Pocket-Book, 1909." Edited by W. H. Fowler. Manchester: Scientific Publishing Co. Price, cloth, 1s. 6d. net; leather, 2s. 6d.

Electric Signs.—The American Consul at Birmingham is urging American firms to try their hand at pushing the electric sign business in this country.

Hardware Trades Exhibition, 1909.—There is to be held in the Royal Agricultural Hall in July next year the eighth Ironmongery and Hardware Trades Exhibition. The organisers are the International Trade Exhibitions, Ltd., of Broad Street House, E.C., who, it will be remembered, were the organising managers of the recent Manchester Electrical Exhibition.

Switzerland.—The Swiss Customs authorities have lately given a decision to the effect that "baths for nickel, copper, or silver-plating, &c.," are to be classified under No. 1,048 of the Tariff, the duty being 2 fr. per 100 kilog.

The Zeal of American Consuls. — The following quotation from the New York *Electrical Record* is published by us as an illustration of the trouble which an American Consul will take in assisting his own countrymen to secure business:—

"In regard to assistance offered to American exporters and travelling agents seeking trade in Nova Scotia, Consul-General David F. Wilbur writes as follows from Halifax: 'Manufacturers and exporters are requested to send catalogues and price lists to consulate-general, covering goods saleable in eastern Canadian markets, to be placed on file in the new commercial room established in this consulate, for use of inquirers desiring information relative to American goods. Ample space is also provided for trade journals, and all publications of this kind are solicited. American salesmen visiting this city are earnestly requested to visit the consulate, which is located at the corner of Granville and George Streets, in the *Halifax Herald* Building, only a short distance from the centrally located leading hotels of the city. We are always extremely anxious to meet American travelling men and aid them in every way possible. It is the purpose to make the commercial room as an assistance to travelling men a leading feature of this consulate-general. Travelling salesmen from the United States are coming to Halifax continually, and yet during the last year less than half a dozen have called at this office. This is not as it should be, as we are in a position at times to give valuable information.'"

Catalogues and Lists. — MESSRS. ARCHIBALD J. WRIGHT, LTD., Leyton Green Road, N.E.—Two lists that are of special interest in view of the approaching Christmas season. One (Section N) is a 32-page illustrated price list of small electrical goods and scientific and mechanical novelties; the other is a leaflet dealing similarly with a few selected lines, such as pocket electric lamps, shocking coils, pins, toy railways, &c.

MESSRS. JOSEPH WESTWOOD & CO, LTD., Napier Yard, Millwall, E.—Pocket pamphlet giving lists of sizes of steel plates, flats, angles, tees, joists, rounds and squares, that they keep in stock in London.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton.—Two additional illustrated price lists: "U," dealing with telephones for domestic use, and for battery call and magneto call, also portable testing telephones; "V" is concerned with electric bells and pushes, replacement indicators, Leclanché cells, &c.

The *Electric Railway Journal*, New York, has sent us a copy of the international edition of its annual "Dictionary of Electric Railway Material," a buyers' guide to advertisers in the journal. There is a European supplement of 18 pages devoted to British and Continental firms.

THE LIGHT ELECTRIC MOTOR CO., LTD., Meads Lane, Seven Kings, Essex.—Two catalogues (of which the trade can obtain copies on application)—one neatly illustrating and stating prices and particulars of their portable electric drilling machines, the other describing Maclean's patent electric motor hair-brush.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, Manchester.—Pamphlet describing the "Exide Accumulator" for ignition and portable purposes, including carriers and crates and hand lamps. The list was prepared before the issue of the S.M.M.T. definition of "ignition capacity," which we published last week, and the capacities listed are based on a 10-hour rate of discharge; on the new system of rating, of course, the batteries would show still higher capacities, but for the sake of simplicity the makers have not taken advantage of this.

THE EXPANDED METAL CO., LTD., Stranton Works, West Hartlepool.—New catalogue (Section 3) of special interest to power station men and to owners of factories and mines where machinery is in operation, inasmuch as it contains illustrations and a few particulars of expanded metal screens and covers for electrical plant. Those included are: Switchboard end screens with doors; switchboard base panels and enclosures; expanded metal doors for oil-switch cells, transformer housings, resistance and starter covers, covers for motor openings and for ventilators, lamp protectors, &c. An impressive list of electricity works and factories for which the firm's screens and guards have been supplied, is given.

MESSRS. ISENTHAL & CO., 85, Mortimer Street, London, W.—New illustrated list, with prices and brief particulars of their precision instruments based on the resonance principle (Patent Frits Lux), including frequency meters, tachometers, ship's telotachometers, frequency meter or synchroniser for paralleling alternators, &c.

MR. HAROLD ASHTON, 8 and 10, Bull's Head Yard, Manchester.—A couple of circulars drawing attention to his anti-vibrator and cord shortener for electric light fittings, and his shadowless light, in which metallic-filament lamps are placed in an inverted shade.

E. LEYBOLD'S NACHFOLGER, Cologne.—32-page special price list with illustrations and descriptions, in English, of Dr. Gaede's high vacuum mercury pump, and other apparatus. Testimonials and lists of users also appear.

THE SWITCHGEAR CO., LTD., Cornwall Buildings, Newhall Street, Birmingham.—A new circular, dated October, 1908, giving prices of their pattern "D" switch fuses, caught together in a binding case with a number of their other previously issued lists of circuit breakers, insulated box spanners, Statter time lag relay, magnetic blow-out fuses for D.C., oil switches, motor starters and motor starting panels, knife switches, and automatic battery regulator.

THE SUNBEAM LAMP CO., LTD., Park Road, Gateshead-upon-Tyne.—New catalogue (Section III) of many patterns of porcelain insulators for various electrical purposes, also ironwork for same. Reference numbers, sizes and prices are stated, and large stocks are held ready for delivery.

SLOAN ELECTRICAL CO., LTD., 15, Fore Street Avenue, E.C.—New list of Conradty's carbon brushes, in which, after views of the Conradty carbon factory, there appear particulars with tabulated sizes and prices, also illustrations, of different qualities of brushes for traction and mine motors, medium and other voltages, D.C. dynamos and motors, also for A.C. and three-phase machines, resistance and switch contacts, Bronskol, &c.

MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., are issuing on their "Tantalum" lamp correspondence a coloured label in stamp form, which is a reproduction of their "Satisfied Consumer" poster. Perforated sheets of these labels will be sent to all requiring them, on application to the firm at 6, Bath Street, City Road, E.C., with trade card enclosed.

MR. ARCHIBALD CAMPBELL, 27, Chancery Lane, W.C.—Leaflets relating to armature binding wires and steel music and music spring wire made by Messrs. Gebrüder Knipping, of Altena-Westphalia, for whom he is British agent.

MESSRS. BROOK, HIRST & CO., LTD., Northgate Electrical Works, Chester.—Pocket pamphlet giving some small and neat half-tone picture of "Brookhirst" switchgear (motor-starting gears and switchboards). Full particulars of the firm's manufactures are contained in a catalogue recently prepared.

THE A.E.G. ELECTRICAL CO. OF SOUTH AFRICA, LTD., Caxton House, Westminster, S.W.—Several new sections of their catalogue dealing with the following:—Their latest model section insulator for electric traction; adjustable cord roller pendants; single-phase commutator motors; lead-covered cable accessories and joint-boxes; high-speed continuous-current motors; and completely enclosed continuous-current motors. A separate catalogue of some 32 pages contains a very fully-illustrated account of their electric locomotives for mines and ironworks.

THE BRITISH ELECTRICAL AND MANUFACTURING CO, Newcastle-upon-Tyne.—New catalogue just issued, in which in the course of some 160 pages are given particulars, numerous illustrations, and prices of a large variety of electrical goods. A number of tables, also rules and data of interest to engineers, are followed by British standard details of pure copper conductors, after which, in different sections to which there is a thumb index, there are set forth the following:—The Simplex coal-cutter, cables, wires and flexibles, insulating materials, insulators, magneto-exploders, water-tight fittings, switches, fuses, &c., motor starters, carbons and sundries. A good paper is used throughout, and altogether the catalogue is well got up.

Dissolutions and Liquidations.—SEVENOAKS MOTOR CAR AND ELECTRICAL CO., LTD.—This company is winding up voluntarily with Mr. A. P. Guerrier, 126, Gresham House, E.C., as liquidator. A meeting of creditors is to be held at that address on November 25th.

WALTERS & CO., electrical engineers and agents, Ocean Chambers, Waterloo Street, Birmingham.—Messrs. V. E. Walters, M. R. A. Hankey, and H. L. Phillips have dissolved partnership. Messrs. Walters & Hankey will attend to debts and continue the business under the old style.

"UNEO" ASBESTOS LUBRICATING CO., LTD.—A meeting is to be held at Empire Works, Prescot, on December 23rd, to hear an account of the winding up.

SPROATES, VICKERS & CO., electricians and contractors, 104, Linthorpe Road, Middlesbrough.—Messrs. H. G. Sproates and G. A. Vickers have dissolved partnership. Debts will be attended to by Mr. Sproates who will continue the business.

MCPHAIL & SIMPSONS' DRY STEAM PATENTS CO., LTD., Calder Works, Wakefield.—December 1st is the last day for the receipt of proofs for intended dividend, by Mr. J. W. Close, North British and Mercantile Buildings, East Parade, Leeds, the liquidator.

British Electromobile Co., Ltd., and Reduced.—A petition for reducing the capital of the above company from £25,000 to £21,072 is to be heard before the Court on November 28th.

Trade Announcements.—THE BRITISH ELECTRIC PLANT CO., LTD., asks us to inform the trade that owing to the rapid extension of their business, and in order to handle matters more speedily, they have appointed the following agents:—For Lancashire and Yorkshire, Messrs. Drennan Glover & Cooper, 429, Corn Exchange Buildings, Manchester; for Birmingham and the Midlands, Messrs. Victor Bernard & Co., Winchester House, Victoria Square, Birmingham; for London and district, Mr. W. M. Harris Burland, 97, Queen Victoria Street, London.

MR. A. J. ROGERS has commenced business as an electrician at 41, Smith Street, Warwick.

LIGHTING and POWER NOTES.

Aberdeen.—The work in connection with the Peterculter extension has been completed by the staff of the electricity department, and cable-laying has been commenced in connection with the supply to the Admiralty wireless telegraph station.

Arabia.—An installation of electric lighting has recently been completed in the Tomb of Mohammed, at Medina.

Barnes.—The electrical engineer has recommended that all lamps in the main roads should be changed from 50 C.P. Nernst type to 100 C.P. Osram. The cost of changing over will be 12s. per post for 150 posts. It was resolved as a commencement that twelve 100-C.P. Osram lamps be placed in the existing posts in Castelnau and twelve in Sheen Lane.

Birkenhead.—A L.G.B. inquiry was held on November 11th into the application of the T.C. for a loan of £20,000 for electric lighting purposes—viz., for extensions of mains, services, &c., for three years. There was no opposition.

Blackrock (Cork).—At a meeting of the District Council last week, the legal adviser of the board, said that he had received the bonds for the completion of the contract for the lighting of Blackrock by the Cork Electric Lighting Co. A representative of the division, however, had given notice that the company be not permitted to execute the bond until the L.G.B. had decided whether the board had power to light the place with electricity against the wishes of the representatives of the people. A discussion ensued, and on a vote being taken, a motion to complete the bonds was passed by 19 votes to 12.

Brighton.—The Corporation has received the approval of the B. of T. to charge 4½d. per unit for electricity for lighting purposes without restriction as to time, and 2d. per unit for power, heating, and cooking purposes, in the parishes of Patcham and Preston Rural, and in the rural district of Steyning East. The Corporation has decided on the charge of 2d. per unit to allow a rebate of ¼d. per unit for every unit consumed in any half-year over and above 250, and ¼d. per unit over and above 500 units.

Clitheroe.—At a recent T.C. meeting a letter was read from the B. of T. in regard to the Electric Lighting Order, asking what steps were being taken to carry it out in Clitheroe. The town clerk was instructed to reply that the matter was having consideration.

Colchester.—The T.C. has decided to erect an overhead feeder cable from the generating station to Hythe Quay at a cost of £675.

Continental Notes. — PORTUGAL. — The electricity generating stations of the Compagnies Reunies Gas et Electricité, of Lisbon, supplied energy to the extent of no less than 3,212,112 KW.-hours for lighting purposes during the past financial year, an increase of 41 per cent. over the preceding 12 months. The quantity furnished to consumers for power purposes advanced to the extent of 220 per cent.—from 212,632 to 685,018 KW.-hours. In order to meet the increased demand a large plot of land on the banks of the River Tagus has been purchased, and on this a new generating station is being established. A new 2,500-H.P. generating set is being put in which will increase the capacity of the available plant to 10,000 H.P.

An exclusive concession has been granted to Joaa Raposo for electrical generation and distribution, by the Camara Municipal of Horta.

AUSTRIA.—The scheme for the establishment of a large power station near Fiume, to which brief reference has previously been made, is promoted by an international syndicate which proposes to utilise the waterfall near Otocaes for this purpose. It is intended to lay a conduit 12 miles in length to carry the water and to erect a turbine equipped power station for 36,000 H.P. as the first instalment, capable of being extended to 100,000 H.P. The project contemplates the supply of energy for lighting and industrial purposes to Fiume and Abbazia and the Dalmatian towns, and the promoters have suggested to the Ministry of Commerce the conversion to electric traction of the railway between Fiume, Kameral and Moravica. The capital of the undertaking is to amount to £1,041,000, and the firm of Ganz & Co., among others, is said to be interested in the project.

BAVARIA.—A company has been formed under the title of Bayerische Naberland-Zentiale Aktiengesellschaft, with a share capital of £125,000, for the purpose of erecting central power and light supply stations in the Palatinat, in order to produce energy direct from the local coal deposits.

Denny.—By arrangement with the Scottish Central Power Co. the electric light has now been introduced into this town. The scheme has been under the direction of Messrs. Stevenson & McGuffie, consulting engineers, Glasgow. The plan suggested was a three-phase system; the installation includes a switchboard, overhead equipment, steel poles, and incandescent lamps, and has been carried out by the British Insulated and Helsby Co. Single bracket 50-C.P. metallic-filament lamps are used for lighting the streets. The lighting is controlled by two switches in the sub-station. There are two three-wire circuits to deal with the private power and light consumption, and in most cases it is anticipated that consumers will be fed by aerial wires direct from the pole to their premises.

Dundee.—With reference to the paragraph which appeared in a recent issue regarding the situation which had arisen over the lighting of the Hilltown district, the Committee concerned had a meeting on the ground, when it was decided to retain the arc lighting. Its decision has since been confirmed by the Council, which has instructed the gas department to have the lamps, which it recently erected, removed. It will be remembered that the gas department erected four lamps, each within 12 yards of the four existing arc lamps.

Egham.—As an inducement to occupiers of houses to take energy for lighting, the Electric Supply Co. has offered to fit up lights and supply electricity for an inclusive charge of 10s. per light per annum, provided the demand warrants the laying of mains. Gas is 3s. 3d. per 1,000 cb. ft.

Glasgow.—The T.C. has accepted the proposal of the electrical engineer, subject to the acquiescence of the Finance Committee, to purchase 200 Osram lamps for St. Andrew's Hall at a cost of £45.

Gravesend.—The T.C. has appointed a Committee to consider the advisability of adopting a system of free or assisted wiring, the work to be done by contractors.

The charge for energy for power and heating on the flat rate has been reduced from 2d. to 1½d. per unit. For power the charge in future is to be 1d. per unit, except on the peak of the lighting load, when the charge is to be 5d.

Hastings.—A L.G.B. inquiry was held on November 11th into the application of the T.C. for a loan of £1,683 for the conversion of 480 street gas lamps into electric lamps. Mr. Horace Avory, K.C., opposed on behalf of the gas company.

Kingsbury.—The U.D.C. has had under consideration an offer by the Gas Light and Coke Co. for improving the public lighting; the matter has been adjourned pending an interview with the North Metropolitan Electric Power Supply Co. on the matter.

London.—MARYLEBONE.—The revenue statement and financial return of the electricity undertaking for the June quarter shows that the total expenditure amounted to £10,722, as against £12,034 for the corresponding quarter of last year. Under all heads the net decrease in cost per unit was ·172d. or nearly 10 per cent. The gross income showed a diminution of £2,501 as compared with the corresponding quarter, brought about by the more extended use of new and economical types of lamps, and a change in the dates of reading the meters—about seven days later than previously. The lower total revenue, which fell from 4·03d. to 3·66d. per unit sold, was chiefly accounted for by the lower average price obtained; the recent change in the tariff also contributes to the fall. The return adds that the sales for the September quarter show that the fall in units sold for the June quarter, has been more than overtaken during the following three months.

L.C.C.—At the meeting on Tuesday the L.C.C. decided to lend £10,637 to the Bermondsey B.C. for the provision of boiler, dynamos, and condensing plant, and to sanction the borrowing by Stepney B.C. of £7,000 as balance of the cost of erecting a generating station at Blyth's Wharf.

At the same meeting of the Council, a recommendation was carried, disapproving of the insertion in the London and District Electric Supply Bill of a clause giving power to purchase by agreement before the period specified in the purchase clause now contained in the Bill, it being considered that an early purchase of the undertaking would expose the ratepayers to the same financial risks as if the Council itself embarked on the enterprise.

WOOLWICH.—Owing to the increasing load, principally due to tramway supply, it has been decided to add certain condensing plant at the Plumstead works, and to provide a cooling pond with piping and spray nozzles.

Lowestoft.—The L.G.B. has sanctioned the borrowing of £1,000 by the T.C. for free wiring, the period allowed being 12 years.

Newcastle-on-Tyne.—During the past week the Newcastle-on-Tyne Electric Supply Co. has held an exhibition of the latest electric heating and cooking appliances. The use of electricity in its domestic applications has extended wonderfully in the North of England recently. This is shown by the fact that while two years ago there were only two electric irons connected with the company's mains, there are now 600. As to electric heating, there are about 1,000 radiators in use in the city.

Port Glasgow.—In connection with the negotiations between the T.C.'s of Greenock and Port Glasgow as regards the electricity question, the Greenock town clerk has written that his Corporation has been advised by its Parliamentary Agent that the preferable procedure would be for the Port Glasgow T.C. itself to apply for a prov. order, and that in the Greenock Bill, power might be taken to authorise the transfer of the Order to the Greenock Corporation, and alternatively Port Glasgow, if it obtained an Order, might agree to take a bulk supply from Greenock. The Port Glasgow authorities state that, in view of the opposition to the Bill as it stands, the T.C. would consider its course of procedure.

Radcliffe.—A L.G.B. inquiry has been held this week into the local District Council's application to borrow £14,000 for the purposes of its electricity undertaking.

Roscrea.—The R.D.C. is inviting electrical engineers and others interested to report on, and estimate the probable cost of, electric lighting in the town.

Surrey.—At the meeting of the County Council last week, it was reported in regard to the Netherne Asylum that the electrical work installed by Messrs. Cash & Co. was finished, and had been tested. The other electrical work, comprising telephones, fire alarms, tell-tale clocks and bells, which Messrs. Cox & Walkers, Ltd., were installing, was nearly completed.

Surbiton.—The U.D.C. has received from the L.G.B. sanction to the following loans:—£1,377 for excess expenditure; £2,000 for mains; £900 for house services; and £676 for meters. The board declined to sanction £1,980 13s. in respect of excess expenditure.

Tynemouth.—Messrs. Handcock & Dykes have been instructed to examine the Corporation's electricity works, and report generally on the condition and management thereof, and particularly as to the charges for lighting and power.

Watford.—The U.D.C. has decided to apply for Parliamentary powers to extend the area of supply to Cassiobury Park, in the rural district; to undertake the free wiring of houses for lighting, power or heating; to supply, fix, repair and remove electrical fittings; and to supply electricity in bulk outside the town.

Whickham.—The members of the District Council have formed themselves into a committee for the purpose of considering the public lighting of the area. Information is being obtained both as to gas and electric lighting.

Wolverhampton.—Mr. F. H. Tulloch, of the L.G.B., held an inquiry on Friday last week, respecting an application by the Corporation to borrow £6,000 for extensions at the electricity works. The town clerk said that it was proposed to provide additional boilers, induced draught plant and coal-conveying plant at the works. The known and anticipated demand at the present time was equivalent to 3,600 KW., and the present capacity of the boiler house was 3,680 KW. The actual increase last year, exclusive of Messrs. Bayliss's order, was 430 KW., and as the demand of the firm named was approximately 1,000 KW., it jointly represented 1,430 KW. There was no opposition to the application.

TRAMWAY and RAILWAY NOTES.

London.—The railway companies owning Victoria Station have officially sanctioned the introduction of electrobuses into the station yard, a privilege denied to all other types of mechanically-driven 'bus.

L.C.C.—The report on the working and future of the "G.B." surface contact tramway (Aldgate-Bow route) evoked a long discussion at the meeting on Tuesday.

It will be remembered that the Council called in Mr. W. M. Mordey, President of the Inst.E.E., to report, and he suggests that to demonstrate the practicability of giving effect to his suggestions the following course should be adopted—

1. A length of not less than half a mile of the track should be overhauled and the studs modified as shown in fig. 2 (this refers to diagram accompanying report). All studs should be tested to a definite standard of working, electrically and mechanically, before being put back on the track.

2. One or two cars should be run over this length of track at night, especially under trying conditions of weather and track.

3. Each car should be fitted with extra contact brushes, connected alternatively to a resistance shunt and to a condenser in order to try both methods. The presence of live studs should be ensured by adding to the mud on the road at a sufficient number of points to enable a thorough trial to be made.

4. The collector should at first be used as it is now, then with two exciting coils only.

The wood coverings of the collector should be made impervious to moisture by soaking in hot paraffin wax or other suitable impregnating material.

The wire and hemp suspension rope should be treated in the same way.

Mr. Mordey does not think it necessary to change the whole of the stud heads for this trial. About 50 cast-steel heads should, however, he states, be put in mainly for finding how much they improve the contact with the collector, by reason of the better magnetic quality of the steel.

The time which would be occupied in making the experiment that Mr. Mordey suggests would not exceed a few weeks, and in all the circumstances the Highways Committee are of opinion that arrangements should be made to give effect to his proposal.

The modifications proposed will not alter the chief features of the system.

The licensors have been furnished with a copy of Mr. Mordey's report, and they have expressed their willingness, if so desired, to adopt the suggestions contained in that report; and they further state that they will be prepared to adapt and work, at their own cost, an experimental length of line, provided the Council allows the equipment and use of not more than four of its cars for the purpose, and undertakes to repay to them the cost incurred in giving effect to the expert's suggestions, if the B. of T. sanction the use of the system as so modified.

The cost of the experiment will be about £500, and some further expenditure will be incurred if the whole route is subsequently dealt with. Mr. Mordey will generally superintend operations.

The recommendation to proceed with the work as outlined in the report, was adopted after strenuous opposition by the Progressive Party, who wished to have the conduit system installed forthwith.

Oxford.—At a meeting of the City Council on Wednesday last week, a report was received from the Tramways Committee on two letters received from the general manager of the National Electric Construction Co., who wrote that any surface-contact system was unsuitable for Oxford. The Construction Co. had secured the contract with the intention of laying down the Dolter system, but it now suggested an overhead system, with the conduit system in the centre of the city. A resolution was passed refusing assent to any variation of the existing arrangements, an amendment to allow such a variation of the contract as would allow the combined system of conduit and overhead traction being defeated by 39 votes to 11.

Peru.—A proposal has been introduced into the House of Senators for the electrification of the Central Railway, for the purpose of increasing its traffic capacity. It is proposed to run steam and electrical trains alternately.—*Board of Trade Journal.*

Quarry Bank.—At the meeting of the U.D.C. last week attention was called to the suspension of the negotiations between the Joint Committee of the Rowley Regis, Brierley Hill and Quarry Bank Councils and Mr. Vesey Brown's company, for the construction of a light railway from Cradley Heath, through Quarry Bank to Brierley Hill; and it was resolved that a conference of the members of all three Councils be held at as early a date as possible to consider the present position and the proposal.

Ramsbottom.—A letter has been received by the District Council (and referred to the sub-Committee) from Mr. E. W. Peterson, of London, inquiring upon what terms the Council would hand over the Tramway Order and purchase tramways on completion of the work.

Sale.—The U.D.C. has decided to lease the tramways to the Manchester T.C. for a period of 35 years.

Sandgate.—The Council has agreed to forego widenings at the Royal Oak, for tramway purposes, in exchange for a lift to be constructed by the Tramway Co., between Sandgate and the camp.

Spain.—La Société des Tramways de Madrid et l'Espagne have secured a concession for an electric tramway in Madrid, from the Gloreta de Alonso Martinez to Chamartin de la Rosa.

Twickenham.—Complaints were made at the last meeting of the District Council in respect of the running of the London United trams, and a resolution was carried suggesting that the cars are, during such periods of the day when used by the working classes, overcrowded; that the cars run with no degree of punctuality; that the cars whilst running are unduly noisy; that the track is in places in an unsatisfactory condition, &c. Unless the matters complained of are remedied, steps will be taken to place the facts before the B. of T.

U.S.A.—According to the daily Press, the Pennsylvania Railroad is making arrangements to electrify the 120 miles of route between Philadelphia and New York, and has contracted for 100 electric locomotives, and for power plants capable of generating 250,000 H.P., with the Westinghouse Co. The initial contracts amount to £1,000,000 in value. It is stated that the company intends to run the 120 miles in one hour.

Yarmouth.—The Tramways Committee have decided to replace life-guards on certain of the old cars which require repairing, with a lifeguard patented by Mr. F. C. Wildbur, their own car-shed foreman, at a cost of 35s. a car, including royalty.

TELEGRAPH and TELEPHONE NOTES.

Insects and Lead-Covered Cables.—The Home Telephone Co., of Santa Barbara, California, has been having considerable trouble, owing to perforation of its lead-covered cables by insects. Some of the trunk lines, consisting of 300-500 wires in lead casings, have been found to have hundreds of perforations about ¼ in. in diameter, and the telephone service has been thereby considerably interrupted. The Queensland Department of Agriculture found that the greatest damage to the cables was caused by the larvæ of the beetle Eceloneru, but that the beetle Xyloper-tha and Bostrichus Jesuita were taken from holes in the casing. It was also found that the elephant beetle would gnaw through the lead sheathing. Similar damage to cables has also occurred in Shanghai and Savannah, Ga.—*Telegraph Age.*

N.T. Co.'s Employés.—Mr. Buxton recently stated that arrangements had been made with the National Telephone Co. to avoid the discharge of employés as far as possible, by putting work in hand earlier than was absolutely necessary, and negotiations were on foot for the co-operation of the Post Office with the company in the continuance of construction works.

Paraguay.—The British Consul in Paraguay states that telegraphic communication was established between Asuncion and Villa Encarnacion in 1907. The line consists of 1,945 kilometres of wire, and the cost of erection was about $32,344. A cable is shortly to be laid between Asuncion and Posadas, thus connecting Paraguay and the Argentine Republic. Other lines are contemplated.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Port Arthur-Chifu	Mar. 9, 1904	
Cotonou-Grand Bassam	Oct. 29, 1908	
Zanzibar-Mombassa	Sept. 11, 1908 ..	Nov. 11, 1908

Telephone Agreements.—Last week an action was brought by the P.M.G. against the Vulkan Garages and Engineering Co., Ltd., to recover £5 12s. 8d. for the use of a telephone. The company was originally a private one, and as such entered into an agreement for a telephone; but on becoming "limited" it repudiated liability, while continuing to use the telephone. Judgment for the plaintiff.

Trans-Canadian Telegraph.—The Grand Trunk Pacific Railway Co. is constructing a telegraph system extending from the Atlantic to the Pacific Ocean, wholly within Canadian territory, and the total mileage will be about 9,000. The terminus will be at Prince Rupert in British Columbia. The capital is $5,000,000. The construction is proceeding simultaneously along the whole route, and it is expected to be open by 1911. It is also intended to extend the system to all points in Canada. On September 21st last the company opened its lines for public service, extending to all offices through the rich fertile provinces of Manitoba, Saskatchewan, and Alberta.—*Telegraph Age.*

United States.—The *Journal of the Telegraph* in publishing details of the Western Union Telegraph Co.'s report, states that the net growth of plant was—in poles and cable 2,831 miles; in wire, 38,231 miles; in offices there was a decrease of 907 due principally to the fact that railway companies have closed many small telegraph offices in consequence of the enactment of laws shortening the hours of labour. Of the total of 1,359,430 miles of wire at the close of the year, 485,801 miles were of copper and 873,629 of iron, an increase in copper of 66 351, and in iron a decrease of 28,120 miles, due to substitution of copper for iron. The number of messages decreased by 12,433,264, and the revenue of the company decreased by $4,274,194 due to depression in business and to the strike of operators, but prospects are improving. The automatic printing telegraph owned by the company has been further installed at Washington, Cleveland, Cincinnati, Kansas City, St. Paul, Omaha, Denver, and Nashville. The cost of construction was $1,138,506, which was $1,734,443 less than last year. Contracts covering 3,113 miles of railway were made during the year.

Wire Thefts.—Serious complaints have been made in the Paisley district as to the cutting and theft of telephone wires, and three men have been remitted to the Sheriff's Court in connection with the matter. It is estimated that about seven miles of wire has been cut down, and the value is placed at £45.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—November 23rd. Stores, including electric lighting material, for the Great North of Scotland Railway Co. Forms of Tender from the Stores Superintendent, 80, Guild Street, Aberdeen.

Australia.—Victoria.—Submarine cable-repairing plant for the P.M.G. See "Official Notices" November 6th.

Queensland.—January 4th and 11th, 1909. Tenders are required by the Postmaster-General for:—No. 1, telegraph instruments, accessories and spare parts; No. 2, telephone instruments, accessories and spare parts; No. 3, switchboards, accessories and spare parts; No. 4, measuring instruments, protectors, accumulators and parts. Tenders for the foregoing by January 11th, 1909; and for cables, copper wire, iron wire and insulators, by January 4th, 1909.

Birmingham.—The Corporation Electricity Department will be glad to hear from firms capable of building large gas engines and producer gas plants. See "Official Notices" to-day.

Brussels.—November 25th. The Belgian Inter-Urban Railways Co. require tenders for cast-iron sockets and mastheads, and 2,300 iron tubes, &c., for overhead electric traction equipment. A copy of the conditions may be obtained by sending 10d. to the Secretaire de la Société Nationale des Chemins de fer Vicinaux, 14, Rue de la Science, Brussels. The same company require tenders for the electric equipment of three sub-stations for transforming high-tension three-phase alternating current into continuous current directly utilisable for the suburban electric railways of their centre district. Plans of sub-stations at 1s. 8d., plans of equipment at 10d., and specifications at 10d., are obtainable from the Secretary. Tenders must be received by registered post by December 2nd.

November 27th.—The municipal authorities require tenders for the supply of electric cables and accessories. The conditions may be obtained on sending a stamped envelope and 5d. to the Echevin, Hotel de Ville, Brussels.

Colchester.—November 30th. Electric lighting plant, motors, wiring, telephones, &c., for the Essex County Lunatic Asylum. See "Official Notices" October 30th.

Dublin.—November 30th. Stores for the Dublin United Tramways Co. (1896), Ltd. See "Official Notices" October 30th.

Hackney.—December 17th. D.C. electricity meters, of the ampere-hour motor type, for the electricity department. See "Official Notices" November 13th.

Hampshire.—Fareham Asylum Visiting Committee of Southampton County Council has decided to extend the electric lighting of the institution in consequence of the gas plant being antiquated and requiring extensive repairs in the near future. Tenders are to be invited for wiring the remainder of the building.

London.—December 1st. Electric lighting, bells and fans for Clapham Secondary School for the L.C.C. See "Official Notices" to-day.

Marylebone.—November 25th. Underground cables, ducts and troughing for the Electricity Department. See "Official Notices" to-day.

Luton.—November 25th. Cast-iron piping for the electricity works. See "Official Notices" to-day.

Manchester.—December 1st. The Tramways Committee invites tenders for tramcar trucks and tramcar resistances (grid type). J. M. McElroy, General Manager, Tramways Department, 55, Piccadilly, Manchester.

Newcastle-on-Tyne.—November 25th. Incandescent lamps and arc lamp carbons for six months for the Tyne Improvement Commission. Commissioners' Engineer, Bewick Street, Newcastle-on-Tyne.

North-Eastern Railway.—December 3rd. Electrical and telegraph stores. E. H. Clark, Gateshead (for electrical stores); C. H. Ellison, Telegraph Superintendent, York (for telegraph stores).

Oldham.—November 20th. Mechanical stokers for the Greenhill generating station for the Electricity Committee. Specifications (one guinea) from Mr. S. W. Newington, Borough Electrical Engineer.

Servia.—November 27th. The Servian Post and Telegraph authorities in Belgrade are inviting tenders for the supply of 45 tons of bronze telegraph wire.

Spain.—The *Gaceta de Madrid* of October 27th contains a copy of a Bill to be laid before the Parliament authorising the Deputacion Provincial of Guipuzcoa to establish and exploit during 35 years an interurban telephone system, to render communication possible between the various towns of the province.—*Board of Trade Journal.*

December 4th.—The municipal authorities of Bayona (province of Pontevedra) are inviting tenders for the concession for the electric lighting of the town during a period of eight years. Tenders are to be sent to, and particulars may be obtained from, El Secretario del Ayuntamiento de Bayona (Pontevedra).

Tyrol.—Hofgartin Communality.—January 1st, 1909. Electric generating station; utilisation of local water-power. Apply by January 1st, 1909, to Gemein de Vreheid.

CLOSED.

Colliery Plant.—Messrs. Crompton & Co., Ltd., have just received an order from Messrs. Cory Bros. & Co., Ltd., for an alternator with an output of 650 K.V.A., 2,200 volts, 25 cycles, 107 R.P.M. This alternator will be a duplicate of the one now being installed by Messrs. Crompton at Messrs. Cory Bros.' Aber Colliery, and will be driven by the large Korting gas engine manufactured and shown by Messrs. Mather & Platt at the Franco-British Exhibition. Messrs. Crompton have also supplied two three-phase high-voltage motors for driving the main haulage. The motors have each an output of 270 B.H.P. and run at a speed of 360 R.P.M.

Cape Town.—The City Council has accepted the tenders of Messrs. G. Findlay & Co. for 1 and 2-H.P. motors, made by Rhodes Motors, Ltd., and of Messrs. Green & Trevett for motors from 3 to 20 H.P., made by the British Westinghouse Co., Ltd. These motors are to be supplied in such numbers as may be required by the Council during the year 1909, in connection with the hire-purchase system inaugurated by the Council. The tender of Messrs. G. Findlay & Co. for motor-starting panels manufactured by Electric Instruments, Ltd., was also accepted.

Australia.—Perth (W.A.).—Postmaster-General :—

General Electric Engineering Co., Perth.—4 000 insulators, 10s. 9d. per gross.
Zwicker, Tod & Co., Melbourne.—30,000 insulators, 2$\frac{29}{32}$d. each; 4,500 sleeves, 5s. per 100; 1,000 ditto, 11s. 6d. per 100.
Unbehaun & Johnstone, Perth.—15,000 insulators, 5½d. each; 2,000 ditto, 4½d. each.
Noyes Bros., Perth.—10 miles 7/16 steel wire, £3 10s. 4d. per mile; 10 miles 7/12 ditto, £8 15s. per mile.
Johnson, Clapham & Morris.—10 cwt. wire, £14 15s. per ton.
Oswald Raes, Sydney.—50 tons copper wire, £76 5s. per ton.
Malloch Bros., Perth.—10,000 binders, £2 1s. 6d. per 1,000; 30,000 tapes, 13s. 4d. per 1,000; 10,000 ditto, £1 7s. 6d. per 1,000.
Noyes Bros., Perth.—50 battery shoes, Couche, Calder & Co., 17s. 4½d. per cwt.; 50 ditto, 17s. 6d. per cwt.

Melbourne.—City Council :—

British Insulated & Helsby Cables, Ltd.—Insulated copper cables, £2,806.
John Danks & Co., Proprietary Co.—Gun-metal and brass castings (annual supplies at schedule prices).
Veritys, Ltd.—25 arc lamps, £108.
G. Weymouth, Proprietary Co.—One 20-h.p. Verity's motor, £50.

Epsom.—Seven tenders were received by the U.D.C. for the supply and erection of a new storage battery at the electricity works, and the Lighting Committee accepted that of Messrs. Pritchetts & Gold, at £286.

Glasgow.—The T.C. Committee on Tramways recommends the acceptance of the following offers :—

Bertram Thomas.—Circuit-breakers for Pinkston power station.
P. & R. Fleming & Co.—Cast-iron brackets and enamelled plates for stopping-place signs.
Ruberoid Co.—P. & B. paint.

Ilford.—The U.D.C. has accepted the tender of the Electric Fittings Co., Ltd., London, for the electric light installation at the Public Library and Public Hall, Seven Kings, at £112.

London.—Messrs. C. Larkins & Co., Ltd., have received the order for the complete electric lighting equipment of the new schools which are in course of erection for the governors of the Sir John Cass Foundation in Duke Street, Aldgate, E.C.

Stepney.—An order has been placed with the Tudor Accumulator Co., Ltd., to substitute a battery with 250 cells for the old station storage battery, at a cost, including allowances for scrap, of £342.

Marylebone.—The tender of Messrs. W. J. Fryer & Co., at £4,426, has been provisionally accepted by the Electric Supply Committee for alterations at the Aybrook Street sub-station. The following tenders have also been accepted :—

Messrs. Sykes & Sugden.—Cut-outs, concentric ·03 and ·06, 7s. each; and triple-concentric ·1 and ·15, 15s. each.
Messrs. Lucy & Co., Ltd.—Triple-concentric cut-outs, ·03, 14s. 3d.; ·06, 14s. 6d.; ·25, 27s.; and ·4, 30s. each. Joint boxes, concentric, ·4-5, ·1 sq. in., £1 12s. 9d. each; triple-concentric, ·4, £1 3s. 6d. Disconnecting boxes, Council's pattern or stock (four-way), £6 5s.; extra for ·4 triple-concentric, 6s. 9d.

Bermondsey.—The B.C. has received the following tenders :—Three inkless recording voltmeters, moving-coil type, direct current, 450 to 525 volts, seven-day clock, continuous roll chart ($\frac{5}{8}$ in. per hour), front terminals :—

Kelvin & James White	£33	15	0
Eversheđ & Vignoles	52	0	0
General Electric Co.	27	4	6
Elliott Bros.	27	7	6
Everett, Edgcumbe & Co.	35	4	9
Everett, Edgcumbe & Co. (alternative) (accepted)	25	12	6

Each of the above is less 2½ per cent.

Three feeder pillars, each fitted with six 200-ampere switch fuses of standard type, and bar for connecting neutrals, mounted on three separate panels, with doors back and front fitted with lock and key :—

Callender's Cable Co.	£46	10	0
Johnson & Phillips (accepted)	42	10	0
Crompton & Co.	46	5	0

100 ft. ·7 sq. in. single cable, insulated with pure and vulcanised rubber, Association 300-megohm grade, taped, braided and compounded over-all :—

Siemens Bros. & Co., Ltd.	£31	17	5
Johnson & Phillips, Ltd.	31	17	5
Callender's Cable and Construction Co., Ltd. (accepted)	31	17	6
British Insulated and Helsby Cables, Ltd.	31	17	6
W. T. Henley's Telegraph Works Co., Ltd.	33	13	2

2½ per cent. less in each case.

L.C.C.—The Highways Committee has had the following tenders under consideration :—

1.—Tramway Reconstruction in Essex Road, &c.

W. Manders (recommended)	£43,534	
Dick, Kerr & Co.	44,038	
J. Mowlem & Co.	44,856	

2.—Supply of Overhead Equipment.

R. W. Blackwell & Co. (recommended)	£7,801	
British Insulated and Helsby Cables	8,229	
Dick, Kerr & Co.	8,266	
S. G. Smith	9,167	
Reid Bros.	11,171	

3.—Water-tube Boilers for Greenwich Station.

E. Danks & Co. (Oldbury) (not to specification)	£25,115	
Clarke, Chapman & Co. (not to specification)	25,875	
Babcock & Wilcox (recommended)	27,526	
Stirling Boiler Co.	27,833	
Richardsons, Westgarth & Co.	29,262	

The tender of Babcock & Wilcox includes £499 for spare parts, but these will not be required, as spare parts are already in stock, and the amount of the tender therefore becomes reduced to £27,027.

It is proposed to extend existing contracts with Henley's Telegraph Works Co. for the supply of low-tension cables for £14,000, with J. H. Tucker for feeder pillars for £400, Johnson & Phillips for switchgear for £460, and the British Westinghouse Co. for motor-generators for the sum of £4,000.

Stalybridge.—The Stalybridge, Hyde and District Joint Tramways Board has accepted the tender of Messrs. T. Bayley and Sons, Ltd., Hyde Junction, for superheaters with Hopkinson-Ferranti valves; and that of Messrs. Edward Wood & Co., Ltd., Salford, for ironwork for boiler-house extensions.

Waterloo.—The U.D.C. has accepted the tender of the Liverpool District Lighting Co. for wiring the new offices for the electric light.

CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDARE.—Extension of Aman schools (£11,780); J. Morgan & Sons, Ltd., builders, 53, Monk Street, Aberdare. Thirty-seven houses, New Street, for the Victoria Building Club; two semi-detached villas, for John Evans, Commercial Inn.

ABERYSTWYTH.—New barracks, at Bulchglas Colliery, for the Scottish-Cardigan Lead Co.

ACCRINGTON.—New school-church at Higher Antley.

ANDERTON (Lancs.).—New school and cookery centre for the C.C. (£4,766).

ASCOT (Sunningdale).—Alterations and additions to Thirklebey House; J. Keith, builder, Sunningdale.

ASHFORD.—Houses, Eastmead Avenue, for T. Gwinnett; Canterbury Road, for Clark Howland, builder, North Street; Kennington, for C. L. Epps, builder, 33, Marsh Street.

ASHFORD (near Bakewell, Derbyshire).—Proposed Central Hospital, for the Haddon District Joint Isolation Hospital Committee (£5,346); W. R. Bryden, architect, Buxton.

ASHTON-IN-MAKERFIELD.—New Baths (£6,000). District Council.

BACUP.—100 houses on the Esher Estate. Borough surveyor, Bacup.

BAILDON (Yorks).—New Wesleyan Sunday Schools (£2,000). T. C. Hope architect, 23, Bank Street, Bradford.

BARNSLEY.—Two houses, Barugh Green; W. T. Turner, architect, Market Hill, Barnsley. Alterations to central premises and proposed laundry; Local Co-operative Society.

BARROW-IN-FURNESS.—Alterations to Oxford Street Schools; Barrow Corporation. Extensions to North Lonsdale Hospital; H. T. Fowler, 6, Cornwallis Street, Barrow.

BECKENHAM.—Houses, Arrol Road, for G. E. Fry; Cromwell Road, for A. and R. Westerman; Stanley Avenue, for J. Overal.

BEDFORD.—Enlargement of concert and billiard rooms. Secretary, Bedford Conservative Club.

BELFAST.—New abattoir for Corporation (£30,000).

BIRMINGHAM.—Probable re-erection (after fire) of paper mills for James Baldwin & Sons, Morville Street.

BLACKHALL.—Important colliery developments. Horden Colliery Co., Ltd.

BLACKROCK.—Working-class housing scheme (£34,000). L. Wickham, chairman of the Urban Council.

BOGNOR.—New Parish Church (£10,000). Jarvis & Co., contractors, London.

BOLTON.—New workshops in Manchester Road; J. E. Johnson, joiner and builder. New Primitive Methodist Church at Daubhill; Trustees.

BRADFORD.—Five blocks of tenement dwellings, Longlands, for the T.C., and extension of laundry at the City Hospital, Leeds Road; City Architect, Whitaker Buildings, Brewery Street, Bradford. Extensions contemplated, Local Co-operative Society.

BRIGHTON.—Alterations, 19, Castle Street; A. H. Lainson, architect, 8, Middle Street. House, Hangleton Road and Tivoli Crescent; E. W. Long, architect, 94, Old Steine, Brighton. Alterations, 21 and 24, Cheltenham Place, for C. R. Sorase-Dickins. Motor shed, Hotel Curzon, Sillwood Street; J. H. Hackman, Ltd., builders, 5 and 12, Western Street. Billiard room, "Spring Lodge," Dyke Road; W. H. Nash, architect, 2, Buxton Road, and 6, North Street, Quadrant, Brighton. Two houses, Windlesham Gardens; T. Garrett, architect, 30, Ship Street, Brighton.

(Preston Circus).—Proposed police station. A. Weller, surveyor, Town Council.

BRISTOL.—Probable re-erection (after fire) of shop premises, Victoria Street. Walter Elson, owner.

BROADSTAIRS.—Two bungalows, Walmsley Road, for Miss Court; additions to Pierremont stables, High Street, for W. F. Whiteing; detached house, St. George's Road, for G. H. Fuggle; three houses, Belvedere Road, for H. J. Hancock.

BROMLEY.—Laundry in Farwig Lane; F. G. Crickett. Six houses, Fairfield Road; Pearce Bros., builders, 87, Hawes Road, Bromley.

BROUGHTON-CUM-BOSSINGTON.—School (£3,000). H. Barber, clerk to County Council of Southampton, Winchester.

CANNOCK.—House at Cheslyn Hay, for the trustees of the Wesleyan Church.

CHARLTON (Kent).—Enlargement of fire station for L.C.C. F. & T. Thorne, builders, Isle of Dogs, E.

CHEADLE.—Houses, Acre Lane, Cheadle Hulme, for Mr. Lowndes; Newbould Road, for Taylor Bros.; Victoria Avenue, Cheadle Hulme, for Westcott & Shorland-Ball; Swan Lane, for W. Rhodes; Moss Lane, Cheadle Hulme, for Woodward & Butcher; Ravenoak Road, Cheadle Hulme, for R. Hazeldine.

CHESHAM.—House, Parkfield Avenue. H. Belch, architect, High Street, Chesham, S.O.

CHICHESTER.—Two villas at Summersdale. F. Hill, builder.

(Stockbridge).—Girls' secondary school, contract £8,989; F. Privell, builder, Southsea. Two houses; W. Aylward, builder, Southsea. Three houses; W. Lewer, builder, Southsea.

CHIPPENHAM.—Business premises in Parkfield, for Downing & Rudman.

CHISWICK.—Additions to the Royal Standard Laundry (£4,500). S. J. Reynolds and H. Hicks, architects, Reigate; Holliday & Greenwood, Ltd., builders, Brixton Road, S.W.

CHOLSEY (Berks.).—Proposed enlargement of Council school. Architect to Berks. Education Committee, Reading.

CLEETHORPES.—New sewerage works, for the U.D.C. (£37,200).

COVENTRY.—Houses, Marlborough Road, for C. Blockley; Lythall's Lane, for W. W. Harris; Highfield Street, for W. H. Brown; White's Road, for W. Hartlett.

DARLINGTON.—Houses, Swinburne Road, for J. P. Pritchett & Son, 24, High Row. Chatsworth Terrace; Kitching & Lee, architects, 14, Blackwellgate. Corner of Four Riggs and Sun Street; Frank Martin, architect, South End Chambers. Lowson Street and Vaughan Street; Clark & Moscrop, architects, Feethams, Darlington.

DARTFORD.—Houses, Fulwich Road; T. Wooller, architect, 31, Priory Villas, West Hill, Dartford. Church, Nelson Road; W. D. Caroe, architect, 3, Great College Street, Westminster.

DARWEN.—Extensions to Starkie Mills. J. Watson & Sons.

DAVENHAM (Cheshire).—Proposed recreation club. Rev. G. R. Sandars' rector.

DERBY.—Extensive additions to Midland Railway Co.'s carriage and wagon works (£36,000). New Congregational Church in Ashbourne Road; Alderman Butterworth, chairman of the Building Committee.

DUNDEE.—Villas in Greendykes Road, for D. Kinnear; alterations and additions to villas in Shamrock Street, for J. Bryson.

DUNSTABLE.—New works for Cross & Co., lace paper manufacturers, 38, Tabernacle Street, London.

DURHAM.—Extension and completion of St. Godric's Roman Catholic Church; houses, Bowburn, for Geo. Wall; Bowburn, for Geo. Brass; High Pittington, for Thos. Simpson.

ELTHAM.—Eight houses, Greenvale and Glenlyon Roads; A. C. Corbett, builder, c.o. J. J. Bassett, 121, Earlshall Road, Eltham.

ENFIELD.—Alterations to the offices of the U.D.C.; Richard Collins, surveyor to the U.D.C., Enfield.

FERNDALE.—New premises for the Ferndale Secondary School. Rhondda Education Committee.

FLEETWOOD.—Important dock extensions. L. & Y. Railway Co., Hunt's Bank, Manchester.

FRINTON-ON-SEA.—Detached house, Second Avenue, for Wheeler & Roberts; two semi-detached houses, Queen's Road, for Mrs. R. Parsons; detached house, Third Avenue, for E. H. Redington; alterations and additions to Lavengro, Harold Grove, for A. Hawes.

GLASGOW.—Additions to Training College, Victoria Road Crescent, for Elizabeth Bellard, Everton Road, Liverpool. Alterations and new buildings at rope works, Caroline Street, for H. Winning and Co.

(Langside).—New Battlefield Church, corner of Ledard and Lochleven Roads (£6,000). H. E. Clifford, architect, 225, St. Vincent Street, Glasgow.

GORTON (near Manchester).—Important extensions at St. Mark's Church (£4,000). Rector, St. Mark's Church, Gorton.

GREAT CROSBY (near Liverpool).—Eleven shops, College Road, for W. Gleaves; detached villa, corner of Woodville Avenue and Coronation Drive, for E. W. Mortlock; two pairs of villas, Brompton Avenue, for W. Delve; pair of villas, corner of Myers Road and Kelvinside, for C. Townshend.

GREATHAM (Hants.).—School. H. Barber, clerk to County Council, Winchester.

HANLEY.—New business premises for M. Huntbach & Co., Ltd., drapers, and alterations to present premises. R. Scrivener & Sons, architects, Howard Place, Hanley.

HARROW.—Seven houses, Parkfield Road. A. Sykes, architect, 45, Finsbury Pavement, E.C.

HASLINGDEN (Lancs.).—Important extensions at local Secondary School (£6,000). Director of Education, Haslingden.

HASLINTON (near Crewe).—New Wesleyan Church (£1,400). Trustees.

HATFIELD.—Houses, Traveller's Lane, for Mr. Sheean-Dare.

HEMEL HEMPSTEAD.—Houses, Belswains, for R. Dowse; Belswains, for T. C. Gold; additions, Fernville, for E. H. Woodman; additions, The Poplars, for Rev. Mother Superior.

HETTON-LE-HOLE (Co. Durham).—Houses, Percy Street, for Mr. Logan; Houghton Road, for J. J. Storey.

HEYWOOD.—Mission Hall at Wham Bar. S. Barker, builder, Pilsworth Road, Heywood.

HINDERWELL (Yorks.).—Two houses, Staithes, for T. Bennison and J. Theaker.

HORLEY (Surrey).—House, Russell Crescent, for A. E. Jennings, builder, Horley.

HULL.—Wesleyan Mission Halls, to be lit by electricity (£11,000). Gelder and Kitchen, architects, Lowgate, Hull; G. H. Panton, builder, 202, Anlaby Road, Hull.

ILFORD.—Houses, Colenso Road, for A. Hodges; South Drive Park, Diprose and Knox, builders, 116, Kingston Road; Stanley Road, for J. French.

IPSWICH.—Public lavatories. E. Buckham, borough surveyor, Town Hall, Ipswich.

KINCARDINE.—Alterations and additions at Gordon Arms Hotel. Davidson and Garden, 12, Dee Street, Aberdeen.

KENYON (near Leigh, South Lancs.).—Extensions at Kenyon College. The Principal.

LEEDS.—Alterations and additions to Millgarth Street Police Station for the T.C. (£2,900).

LEICESTER.—Proposed public hall for the T.C. (£15,000).

LEIGH.—New milk and provision stores. Board of Guardians.

LITTLE HULTON.—New premises for the Co-operative Society. J. T. Proffitt, architect, Walkden, Manchester.

LLANDAFF.—Twelve houses, Newfoundland Road, Gabalfa. T. H. Price, builder.

LLANISHEN.—Two villas, Cardiff Road. A. W. Chick, builder.

LONDON (Tottenham, N.).—Workshop for J. A. Prestwich, Lansdown Road, Tottenham. N. Additions, Tottenham Theatre; Wylson and Long, architects, 16, King William Street, E.C. Iron church, Stanhope Gardens, for Rev. J. H. Greaves; boiler house and chimney shaft at factory, Ryde Road, for Millington & Sons, Crown Works, Tottenham. Twenty-six houses, Carew and Kimberley Roads; T. Willers, care of J. Treacher & Sons, architects, 64, Moorgate Street, E.C. Four houses, Fairview Road; J. C. Isaacs, care of E. Evans, 253, Lavender Hill, S.W. Twenty-four houses, Kimberley Road and Dowsett Avenue, also two houses and shops, Dowsett Avenue; H. Foster, care of J. Treacher & Sons, architects, 64, Moorgate Street, E.C.

(Woolwich, S.E.).—Temporary buildings at Union Street and Wood Street Schools. T. J. Bailey, Education architect, L.C.C. offices, Victoria Embankment, W.C.

(Dulwich, S.E.).—Mission Hall at Bassano Street, for the Rev. A. Eglington, St. John's Vicarage, East Dulwich, S.E.

(Bermondsey, S.E.).—New factory for Sir W. P. Hartley, Green Walk, Tower Bridge Road, S.E.

(Tooting, S.W.).—Additions to Anglo-American Laundry (£2,000); S. J. Reynolds & H. Hicks, architects, Reigate and Broadstairs; Holliday & Greenwood, builders, Brixton Road, S.W. Hall, High Street; H. Roffey & Sons, builders, 26 and 28, Charlwood Road, Putney, S.W.

(S.W.).—New premises in Queen Anne's Gate and Birdcage Walk, for the Anglo-American Oil Co., Ltd. (£50,000 or £60,000); Ernest Runtz & Ford, architects, 10, Walbrook, London. Eight houses, The Grove; H. Buchan, builder, 17, Standard Street, New Kent Road, S.E.

LONDON (Streatham, S.W.).—Addition to Convent of St. Andrew, Coventry Hall, Polworth Road. E. Goldie, architect, 31, Upper Phillimore Place, Kensington. Alterations and additions to St. Leonard's Girls and Infants' Schools, Mitcham Lane. J. H. Jenkin & Co., builders, 36, Mitcham Lane, Streatham.

(Hammersmith, W.).—Shops at 93 and 95, Wood Lane; W. Palmer, builder, 75, Dulwich Road, Herne Hill S.E. Additions to West London Laundry (£1,170); S. J. Reynolds & H. Hicks, architects, Reigate and Broadstairs; E. A. Roome & Co., builders, Basinghall Street, E.C.

(Walworth, S.E.).—Police station at Carter Street (£13,800). J. Dixon Butler, surveyor to Metropolitan Police, New Scotland Yard, S.W.

(Southwark, S.E.).—Printing works, Brunswick Street; G. F. Collinson, architect, 81, Hallam Street, Portland Place, W. Re-erection of buildings in Shaftesbury, Thornton, South, and Aylesbury Streets; T. W. Sloman, jun., South Street, Walworth, S.E.

(Canonbury, N.).—New schools for girls and infants in connection with St. Paul's Church (£4,500). Rev. W. A. Smith, vicar of St. Paul's.

(Deptford, S.E.).—Postmen's sorting office. Postmaster-General.

(Lewisham, S.E.).—Seven houses, Merchiston Road. Norfolk and Prior, architects, 4, Station Place, Catford Hill, S.E.

(Whitechapel, E.).—Re-erection of 11 and 12, Duval Street. C. E. Salmon, architect, 20, Bell Street, Reigate, Surrey.

(Paddington, W.).—Additions to the South Block of the Workhouse. H. F. Aveling, Clerk to the Guardians, 318-319, Harrow Road, W.

(Golder's Green, N.W.).—New church for the Parish of All Saints, Child's Hill. Wills & Anderson, architects, 24, Bloomsbury Square, W.C.

(Plumstead).—Shop, Herbert Road; T. S. Nash, builder, 42, Union Street, Woolwich. Addition to Church of the Ascension; A. E. Habershon, architect, 29 and 30, Green's End, Woolwich.

(Barnes, S.W.).—Development of Barker and Temple Grove Estates, Mortlake. Four houses, Temple Sheen Road; Tyers and Jago, architects, 10, John Street, Aldelphi, W.C. Addition, Lawn Convent Schools, Church Road; Mother Superior.

(E.C.).—Factory building at Little Britain, E.C. G. Vickery, architect, 96, Queen Street, Cheapside, E.C.

LOUGHBOROUGH.—Proposed new higher elementary school, for the Education Committee.

LOWESTOFT.—Two houses, Beccles Road, for A. Andsell, Lowestoft; two houses, Kutslew Park Road, for Mr. Critoph; six houses, Worthing Road, for S. and B. Swatman; new shops, Clapham Road, for Co-operative Society.

MACCLESFIELD.—Probable re-erection (after fire) of works at Rainow, for Jas. Heathcote & Sons, cotton doublers.

MANCHESTER.—Extension to Walton House, Harrison Street, Ancoats; City architect, Town Hall, Manchester. New St. Luke's Church, Lightbowne. Rebuilding the Star Hotel, Deansgate.

(Higher Openshaw).—New Wesleyan Sunday Schools (£3,000).

MARKET RASEN.—Wesleyan Church at Owersby. W. Chapman, architect, Sheffield; P. McGinnis, builder, Market Rasen.

MEVAGISSEY.—Residence at Portmellon, for W. Williams.

MILNROW and NEWHEY (near Rochdale).—Extensions at Working Men's Club. Secretary.

MILNSBRIDGE (Yorks.).—House and shop, Cowlersley Lane. Lunn & Kaye, architects, 14, John William Street, Huddersfield.

NELSON (Lancs.).—Improvements at sewage works. Borough Surveyor.

NORTHAMPTON (Walgrave).—New schools. Sharman & Archer, architects, Market Square, Wellingborough (subject to terms being arranged).

NORWICH.—Proposed new infirmary, with electric lifts, &c. (£11,000). B. B. Morgan, architect, 6, Bank Street, Norwich.

NOTTINGHAM.—School at Trent Bridge. F. B. Lewis, City Architect, Guildhall, Nottingham.

OLDBURY.—Houses, Barclay Road, for E. J. Shipman; Galton Road, for J. Waterhouse; Moat Road, for Mrs. Lewis; shops, Birmingham Street, for T. Newman, butcher; extensions to premises, Rood End, for Rider & Co.

OLDHAM.—Important waterworks extensions at Butterworth and Saddleworth. Borough Surveyor, Oldham.

OVENDEN (near Halifax).—Additions to works. J. F. Walsh & Graham Nicholas, architects, Museum Chambers, Halifax.

PENTREBACH (near Merthyr Tydfil).—Shop premises. Taibach Lane. T. Edmund Rees, architect, Gernant, The Walk, Merthyr Tydfil.

PERTH.—Double villa in Rose Crescent; James Ross, builder. Alterations at 24, St. John Street for W. Watt, seedsman. Tea rooms in Scott Street, for Co-operative Society; John Clark, manager.

PONTARDULAIS (Glam.).—New vestry at Hope Chapel. J. Davies & Son' architects, Cowell House, Llanelly.

PORTSMOUTH.—Probable re-erection (after fire) of shop premises, 332, Commercial Road, for Burch & Blackman, grocers (lit by electricity).

Shop, Castle Road, for G. H. Cox, Castle Road; F. Corke, builder. House and stable, Stubbington Avenue; E. W. J. Payne, builder. Houses and shop, Powerscourt Road; Smith & Morey, builders. House, Highgate Road; E. G. Bedford.

RADCLIFFE (Lancs.).—Electricity works extension (14 000). District Surveyor.

RAMSBOTTOM (Lancs.).—New store rooms at Edenfield. Mrs. Margaret Haworth.

READING.—School, Northumberland Avenue; Rowland Howell, architect, 17, Blagrave Street; H. Godwin, builder, Church Street, Reading. Alterations and additions to the workhouse; the Workhouse Master.

ROCHDALE.—Suggested extension of Town Hall (£20,000). Borough Engineer, Rochdale.

ROGATE (near Petersfield).—House at Fyning Common. W. R. Howell, architect, 5, York Buildings, Adelphi, London, W.C.

ROWLEY REGIS.—School for 310 boys, at The Knowle. D. Wright, secretary to the Education Committee, Council Offices, Old Hill, Staffs.

RUGBY.—New theatre for Wentworth Croke, proprietor of the Lyric Opera House, Hammersmith; W. H. Percival, architect, 12, Craven Street, Strand, W.C.; Foster & Dicksee, Ltd., builders, Rugby.

ST. ALBANS.—Sewage works and machinery for the T.C. (£5,497). H. Howard Humphreys, engineer, 28, Victoria Street, London, S.W.

ST. AUSTELL.—Two houses for J. H. Rowe, Tregonissey, St. Austell.

ST. DENNIS (Cornwall).—Two houses for H. Yelland, St. Dennis.

SANDHURST.—Council school (200 children). W. H. Robinson, architect to the Kent Education Committee, Caxton House, Westminster, S.W.

SANDWICH.—Waterworks machinery for the T.C. Anson & Shenton, engineers, 28, Victoria Street, Westminster, S.W.

SELSEY.—Two shops; H. A. Smith, builder. Villa, A. G. Cutler.

SEVENOAKS.—Two houses, Tubs Hill; Henry Eeles, builder, 14, Eardley Road, Sevenoaks.

SEVEN SISTERS (near NEATH).—Sixteen houses on Ynysdawl Estate. John Williams, Stillau Gwynion, Seven Sisters, Neath.

SMETHWICK (near BIRMINGHAM).—Technical school, including laboratories (£20,000). F. J. Gill, architect, 296, Rolfe Street, Smethwick.

SOLIHULL (near BIRMINGHAM).—Isolation Hospital for the Solihull and Meriden R.D.C.'s. W. H. Ward, architect, Paradise Street, Birmingham.

SOUTHAMPTON.—Proposed installation of electrical organ-blowing apparatus at St. Mary's Church.

SOUTHEND-ON-SEA.—Shops and premises, Station Road and Pembury Road, for J. May; alterations and additions, North Road and London Road, for W. P. Mara; conversion of houses into shops, Cowper Villas, Clarence Road, for W. T. Darke, builder, 54, Alexandra Street; alterations, &c., 22 and 24, High Street, for Barclay and Co. Ltd., bankers, Lombard Street, London; proposed lock-up shops, Lower Esplanade, for F. F. Ramuz; houses, Macdonald Avenue, for C. H. Jerrard; Elderton Road, for S. E. Adams; Hainault Avenue, for W. T. Wilson; Drake Road, for Chas. Dougal; Drake Road, for Guy Collier; Grand Parade, for Mrs. W. A. Willett; Beach Road, for J. Elmer; Leigh Road West, for J. Jeffree; Hainault Avenue, for W. Jones, jun.; Southchurch Road, for J. Sears; Bournemouth Park Road, for W. Bray; Stornoway Road, for Goldsworthy Bros., builders, Ilfracombe Avenue; Sandleigh Road and Fernleigh Drive, for C. G. Jay; Somerville Gardens, for H. Walton; Silverdale Avenue, for W. Gimbrett; Ailsa Road, for J. Poulton; Southchurch Beach Parade, for Miss M. A. Bland; Inverness Avenue, for W. G. Wharf; Queen's Road, for J. Porter & Co.; Eastwood Road, for B. Lawford. Six houses, Fairfax Drive; E. H. Elgar, architect, Holloway, N.

STEVENSTON (AYRSHIRE).—Double villa. Alex. Thorn, Stevenston.

STOURBRIDGE.—Parish room at Wollaston. Rev. G. Gilbanks, vicar of St. James's, Wollaston, Stourbridge.

STROUD (GLOS.).—Proposed enlargement of the head Post Office.

SUTTON-IN-ASHFIELD.—Houses, Hardwick Lane, for Gore & Shore; Queen Street, for E. Thompson; Bathwood Drive and Station Road, for S. Crossland: alterations and additions to premises, King street, for Dr. Nesbitt.

SWADLINCOTE.—Houses. North Street, for J. R. Winson; Oxford Street, for J. Morton; Thorntree Lane, for J. W. Moore: Sunnyside, for H. Lester; Beard's Road, Newhall, for Joseph Parker.

SWANSEA.—Houses: Fforestfach, for Evan Thomas; Pantlasau, for T. J. Williams; Mynydd Carnllwyd, for D. J. Jones; Morriston, for Jas. Hughes; Bwilfa, for Ivor Hopkins; Glais, for Wm. Harding; Glendros, for Thos. Roberts.

SWINTON and PENDLEBURY.—Electrical storage shed; Surveyor, Swinton and Pendlebury District Council, Manchester. Proposed electric power installation at the works of Messrs. Holland, iron founders, Chorley Road.

TEDDINGTON.—Additions to Dunbar House, for Mr. Willing.

TENDRING.—Cottage homes; J. H. Sizer, chairman of the Tendring Board of Guardians.

THAMES DITTON.—New Church and Sunday Schools at Hare Lane, Claygate. Mr. Higby, builder, Portsmouth Road, Thames Ditton.

Store at Esher for J. Burn & Co., Ltd., Royal Mills.

THORNE (near DONCASTER).—New temperance institute (£1,250). F. Chambers, architect; Goole; Mr. Drury, builder, Thorne.

TRURO.—Residence in Carvoza Road. J. H. Pill & Son, builders.

TUNBRIDGE WELLS.—Houses, Hopwood Gardens, for F. T. Baker; Culverden Avenue, for G. Eldridge: Culverden Avenue, for W. J. Hales; Molyneux Park, for E. Winchester; motor house, 3, Culverden Gardens, for Dr. Riley. Club house, London Road, for the Tunbridge Wells Club; F. W. Elers, J.P., hon. sec.

TWYNYRODYN (near MERTHYR TYDFIL).—Fifteen or more houses for the Caemarydwn Building Club. O. P. Bevan, architect, *Express* Chambers, Merthyr Tydfil.

USWORTH (Co. DURHAM).—Fifty houses for the C.C. (£9,212). D. Chambers, builder, Usworth.

WALKDEN.—New engine houses and deepening of shaft at Mosley Common ventilating pits; Captain H. V. Hart-Davis. Bridgewater Offices, Walkden, Manchester. House in Manchester Road; W. J. Simpson, mineral water manufacturer, Walkden; 40 houses at Tynesbank, for Lord Ellesmere.

WALTON (SURREY).—House, Duffield's Lane, for W. H. Fowler, Golf Club House, Walton.

WALTON-LE-DALE (LANCS.).—New waterworks scheme. Surveyor, Council Offices, Walton-le-Dale.

WARRINGTON.—Public mortuary at Frodsham. Surveyor, Rural Council, Runcorn.

WATERLOO (near LIVERPOOL).—Ten houses, Ronald Road, for Stephen Ashcroft, builder, Oakfield Road, Anfield; alterations and additions to 51 and 52, South Road, for Edward Pearson.

WATERLOO (HANTS.).—Enlargement of school and new offices (£1,578). H. Barber, Clerk to the County Council of Southampton, Winchester.

WATFORD.—House at Hazlewood, Abbots Langley, for the Rev. H. Gladstone. Prospective adaptation of Boys' Grammar School for a Higher Elementary School, also erection of Boys' Grammar School on a new site. J. Wilson, Clerk to Managers of Watford County Council Schools.

WEDNESFIELD.—Proposed new church at Fallings Park.

WEMBLEY.—Police station (£5,200). J. Dixon Butler, surveyor to Metropolitan Police, New Scotland Yard, S.W.

WEST HARTLEPOOL.—Storage room for the Hartlepool Pulp and Paper Co.

WEST KILBRIDE (AYRSHIRE).—Villa in Caldwell Road. Jas. Blair, Caldwell Road, West Kilbride.

WEYBRIDGE.—New police station (£2,900). F. & H. F. Higgs, builders, Herne Hill, S.E.

WHITCHURCH.—Three houses in Philog Road; J. Lewis, builder. Two houses and shop in Station Road; S. Shail, builder. Two houses, Church Road, and five houses Alfreda Road; J. Kitto, builder. Three houses, West Road; S. Shail, builder.

WHITSTABLE-ON-SEA.—Houses, Island Wall, for Geo. Reeves; Northwood Road, for F. S. Gann.

WIGTON (CUMBERLAND.—Probable re-erection (after fire) of engineering works, Station Road, for John Hall (electrically equipped).

WINDSOR.—Additions to residence at British Schools, for the Rev. P. H. Eliot, Windsor.

Alterations and additions to Boys' Secondary School for Berks. C.C. (£2,200).

WITHNELL (near CHORLEY, LANCS.).—Workshops, Bury Lane, R. Brown; extensions to premises, W. Hull.

WOKING.—Additions to the Police Station buildings for the Surrey Standing Joint Committee (£250). Enlargement of Church Street School; Rev. F. J. Oliphant, chairman of the Woking School Managers.

WOLVERHAMPTON.—Proposed new premises opposite Queen Square for the Prudential Assurance Co., Holborn Bars, London, E.C.

YARMOUTH.—Additions to Silk factory. Olley & Reward, architects, 5, Queen Street, Great Yarmouth.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 20th).—At 8 p.m. At the Institution House. Institution of Mechanical Engineers. Papers on "The Resistance of Metals to Impact," by Messrs. T. E. Stanton and L. Barstow, and "Different Methods of Impact Testing on Notched Bars," by Mr. F. W. Harbord.

At 8 p.m. At the Siemens Institute, Stafford. Conversazione of the Siemens Engineering Society.

At 7.30 p.m. At Sunderland. North-East Coast Institution of Engineers and Shipbuilders. Paper by Mr. J. B. Duckitt on "The Electrical Equipment of Cranes."

Saturday, November 21st.—Association of Engineers-in-Charge. Social. Dance.

Tuesday, November 24th.—At 7.30 p.m. At the Municipal School of Technology Institution of Electrical Engineers, Manchester Students' Section Paper on "Central Station Design," by Mr. J. H. Baxter.

At 8 p.m. At Stone's Restaurant, the Broadway, Ludgate Hill, E.C. Institution of Electrical Engineers, Students' Section. First annual smoking concert.

Wednesday, November 25th.—At 7.15 p.m. At the University, Leeds. Institution of Electrical Engineers, Leeds Local Section. Paper on "Comparison of Natural and Induced Draught Systems," by Mr. W. N. Y. King.

Thursday, November 26th.—At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. Paper on "Domestic Electric Supply (Including Heating and Cooking) as Affected by Tariffs," by Mr. W. R. Cooper.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued:—

Monday, Nov. 23rd.—"A" Company. Infantry drill (Recruits) 6 to 7 p.m. Technical drill, 7 to 10 p.m.

Tuesday, Nov. 24th.—"B" Company. Infantry drill (Recruits) 6 to 7 p.m. Technical drill, 7 to 10 p.m.

Thursday, Nov. 26th.—"C" Company. Infantry drill (Recruits) 6 to 7 p.m. Technical drill, 7 to 10 p.m.

Friday, Nov. 27th.—"D" Company. Infantry drill (Recruits) 6 to 7 p.m. Technical drill, 7 to 10 p.m.

Tuesday, Nov. 24th.—Medical inspection for recruits, 6.30 to 7.30 p.m.

Wednesday, November 25th.—Lecture by Capt. Phillips for Corporals. Any other N.C.O.'s may attend.

(Signed) J. H. S. PHILLIPS,
Capt. and Acting Adjutant.

NOTES.

Electro-Deposition of Nickel.—In a recent investigation, carried out at the Columbia University by Dr. Kern and F. G. Fabian, many interesting facts came to light with respect to the deposition of nickel. The full report is contained in the July number of the "School of Mines Quarterly," which gives an exhaustive review of present methods either proposed or adopted. In addition to these many new facts are given, which are briefly summarised below. In the first place, it is stated that the conductivity of an electrolyte varies directly as the mass of salt in solution, and the more concentrated the electrolyte, the more satisfactory the deposit. As examples, lead fluosilicate, silver nitrate, gold chloride, nickel chloride, and antimony fluoride may be cited, all of which yield better deposits than less soluble salts. Another advantage gained by using very soluble salts is the lessening of crystallisation, which may prove a serious obstacle to efficient working. For this reason the investigation has been largely occupied with the very soluble salts of nickel. In all experiments cast nickel anodes containing 92 per cent. of nickel, 5 per cent. of iron, carbon and a trace of copper were used. With nickel dithionate a separation of sulphur was obtained which made the process valueless. The presence of free acid in nickel chloride, nickel sulphate, and nickel fluosilicate electrolytes caused a very low cathode efficiency, whereas the anode efficiency was in most cases over 95 per cent. But with continued electrolysis the free acid was neutralised, and the cathode efficiency increased. The electrolysis of neutral chloride and fluosilicate solutions with current densities of 10 to 20 amperes per square foot gave very satisfactory deposits and high current efficiencies. Neutral sulphate solutions, on the other hand, deposited precipitates of insoluble basic salts which intermixed with the deposited nickel. Heating the chloride and fluosilicate electrolytes decreased the P.D., increased the current efficiencies, and improved the deposition. The most satisfactory temperature was about 50° C. During the electrolysis of fluosilicate solutions, a small amount of gelatinous silica separated and collected on the bottom of the cells. Heating these solutions above 75° C. also caused the separation of silica, but very slowly. A small amount of basic salts separated during the electrolysis from neutral chloride electrolytes, but these did not interfere with the deposition. A small amount of free acid prevented this formation.

The Transmission of Compass Indications to a Distance.—With the increasing displacement of war and other ships, the difficulty of finding suitable positions for the various compasses on board becomes serious. To meet the case, Messrs. Siemens & Halske have designed an arrangement based on Prof. Einthoven's patents. It consists of a master compass, erected in some position in which it is free from magnetic disturbances, and as many auxiliary compasses as desired, the auxiliary compasses being of a special type unaffected by external magnetic fields. The moving system of the master compass carries a screen with a quadrant-shaped slit in it. Underneath this screen a tinfoil grid, made up of four quadrants, is arranged, and the radiation from a fixed incandescent lamp falls on the grid through the slit in the screen. Uniformity of heat distribution is attained by mounting the system on a massive copper plate. Each pair of tinfoil quadrants, in combination with two fixed resistances, forms a Wheatstone bridge, and the two bridges thus obtained are connected in series. One diagonal of each bridge is connected to one of the two coil systems of the auxiliary compasses. These coils are arranged for deflection in a magnetic field. In this way, any motion of the master compass results in the heat from the lamp altering the resistance of one or the other bridge arm, thus sending currents round the coils of the auxiliary compasses in one or the other direction, and causing these compasses to be deflected by just the same amount as the master compass.—*E.T.Z.*, October 29th, 1908.

London Traffic.—At the latter end of last year, it will be remembered, a London Traffic Branch of the Board of Trade was constituted, under the control of Sir Herbert Jekyll, with a view to its accumulating information and reporting from time to time on London traffic problems. The first annual report of this branch was issued on the 16th inst., and includes some 170 pages of reading matter. The report is in sections, dealing with street improvements, means of locomotion, &c.

As regards the former, it is pointed out that such improvements as have been carried out are of an isolated character, valuable in themselves, but having little relation to each other or to the general requirements of London.

The sections relating to public carriages, tramways, and railways, are of more direct interest to our readers. The number of licences issued for public carriages did not vary very greatly in the years 1903-7, but owing to the introduction of mechanical traction there were considerable changes in their distribution. The number of hansoms fell off by over 1,500; but that of four-wheeled vehicles remained nearly constant, though the number propelled by mechanical power rose from 1 in 1903 to 723 in 1907. Omnibuses showed a total increase of only 126 but the number mechanically propelled increased from 13 to 1,205. Tramcars rose from 1,719 to 2,172, and while those drawn by animals declined from 1,143 to 404, mechanical power was used in 1,768 in 1907, as against 576 in 1903.

The insufficiency of the London tramways is pointed out, their lack of harmony in working, of through running and booking, and mention is made of the controlling influence of the Underground Electric Railways Co. of London over the various tube and underground railways, a suggestion being thrown out that the principle of single control might be extended to all the electric railways, tramways, and even omnibus services.

Sir Herbert Jekyll considers that competition has been carried to excess, and that the present low rates lead to failure to earn dividends which must ultimately check enterprise. He further suggests that tramway extensions on a large scale, with through running, seem to offer the best means of dealing with the dense suburban traffic up to 8 or 10 miles from the centre.

The last three sections refer, among other things, to the defunct Thames steamboat service, and to the changes which have occurred since the completion of the Royal Commission's inquiry. These may be summarised as follows:—

26½ miles of new tube railways.
Electrification of 68 miles of railway.
80 miles of new electric tramways.
Electrification of 28½ miles of horse tramways.
Opening of Vauxhall Bridge and Rotherhithe Tunnel.
1,000 motor-omnibuses, and a large number of motor-cabs.
Connection between tramways north and south of the Thames.

But the report points out that nothing has occurred during the last three years to weaken the recommendations of the Royal Commission; the general situation remains the same, the evils remain practically unchecked, and the need for remedies is possibly greater than it was.

As regards the constitution of a traffic board, it is suggested that London traffic problems can only be dealt with by a permanent body giving continuous attention to the matter. To devise a scheme for future action will require a large amount of work, and until this has been done it is difficult to see how progress can be made.

There are five appendices giving statistical information regarding London traffic, also memoranda on German and American municipal government, and certain diagrams.

Penny-a-Word Telegrams.—A contributor, writing on this subject, suggests that by gradual progress possibly a much reduced telegraph rate may be arrived at which will not cause a loss to anyone. The present time may not be opportune for introducing it, but a few years hence it may be possible when the facilities have been found on some, if not all, of the lines.

It is not, he says, the time to discuss the abolition of frontiers; when the question of cheaper telegraph rates has been determined in the Empire, rather will it be more certain, and once the British Dominions are in enjoyment of as reasonable a rate as can possibly be conceded, foreign countries must follow suit and reduce their rates in order to facilitate the transaction of business and to give their people the same facilities as their competitors.

One of the considerations in favour of landing cables on British territory is often lost sight of. There is no law permanently limiting a State with regard to the transit rate or terminal tax, and it must be conceded that the time for putting our lines of communication into foreign hands has not yet arrived. This is hardly the article in which to bring in "fiscal" reform; nevertheless, it seems a point worth considering whether the power to tax telegrams is not one to be evaded. Not many lines are needed to provide an all-round-the-world "red" cable, which is necessary for our future protection in this and other respects.

Searchers after Imperial unity think communications must be one of the means towards that end; if that be so the Empire must control them, and if it do so, the reasonable question to ask seems to be, can it, like the private companies, work them at a profit? By some it is said not, and the Postal Telegraph Department and the Pacific cable are given as the sad examples of State mismanagement. In the former, expenditure on extensions and the erection of new lines is generally charged to the year's revenue, and besides this the Government has connected many places which do not, in a commercial sense, pay. If such places could be eliminated, and accounting conducted as in a commercial business, would the Postal system show a deficit? Private companies receive subsidies for non-paying lines, otherwise they would not be laid, and this comparison should not be lost sight of, as it is hardly fair to call a shortage in a Government account a "deficit" if it can be made clear that it is not. It has always been stated that the Pacific cable system has a deficit of £50,000. Is this also because it is a Government undertaking? On the other hand, it must save the community about £200,000 annually in telegraph charges. The effect of this should improve trade, and in an indirect manner the £50,000 would be returned to the whole community. If this be so, the argument that the public are paying for the few seems to be "window dressing," for there are many private companies receiving subsidies, some in lieu of sufficient traffic, to support them.

These and other questions, says our contributor, especially the one as to telegraph charges, appear to be rather in want of a close investigation by a suitable committee. It is not advisable that they continue as at present, as they cause an unnecessary spirit of unrest so long as they remain in any other than a concrete form.

The Brake Committee's Report.—Mr. Freund has written to us to point out that the report does scant justice to his ingenious brake, as both references to it concern the old hand-wound type, whereas, with the axle-wound type, which was described in our issue of September 11th, and has been in operation for over six months, 25 per cent. to 30 per cent. better results have been obtained, and there is not any indication that the limit has been reached.

It does seem to us that some injustice has been done to Mr. Freund, although we are quite sure that the Committee was unconscious of it, for Mr. Sayers made a report for Mr. Freund on July 4th last upon the axle-wound form, and was pleased to speak very highly of its performance, concluding his remarks with the statement that the brake was suitable for use as a service brake, a consting brake and an emergency brake.

Turning to page 900 of the Special "Brakes" number of the "Official Circular," we find that the Committee did not actually test Mr. Freund's brake, but accepted the series of tests made in November, 1906, in the presence of Lieut.-Colonel Druitt for the B. of T. and representatives of the Yorkshire Electric Tramways Co., Ltd. These tests are reproduced on page 904 of the "Official Circular." On pages 811 and 812 a description of the Freund brake (old form) is given, and under the "disadvantages" the brake is said to have the following faults:—

(*a*) Unsuitable as a service brake.
(*b*) Manual labour required.
(*c*) Slowness in release.

But the last sentence reads:—"It is understood that in a later type than that inspected, the winding-off is effected automatically from the axle."

We realise the utter impossibility of any report of the widely comprehensive nature of that issued by the Brakes Committee being revised up to the date of issue, and we are quite prepared to find that many of the appliances mentioned therein have been improved greatly since they were inspected by the Committee, but it is not so clear why information which was available to the general public in July, and perhaps earlier, should not have been allowed to modify much more effectively than it has done the unfavourable criticism of the Freund brake in the report issued to the public in November, but dated September.

We have no doubt, however, that the Committee has a complete explanation if it cares to produce it.

Storage Battery Patents in Germany.—It is announced that the Imperial Patent Office authorities proposed some time ago to grant an application made by the Berlin-Hagen Accumulator Works Co. for a patent relating to a process for separating the electrodes of electric storage batteries by means of small wooden partitions. The question at issue was that of placing the so-called diaphragm plates under protection, respecting the employment of which opinions in technical circles are divided. Various objections raised against the proposal to issue a patent have been dismissed, but that brought forward by the Accumulator and Electricity Works (late Boese) Co. is reported to have been sustained, and the granting of the patent has been refused.

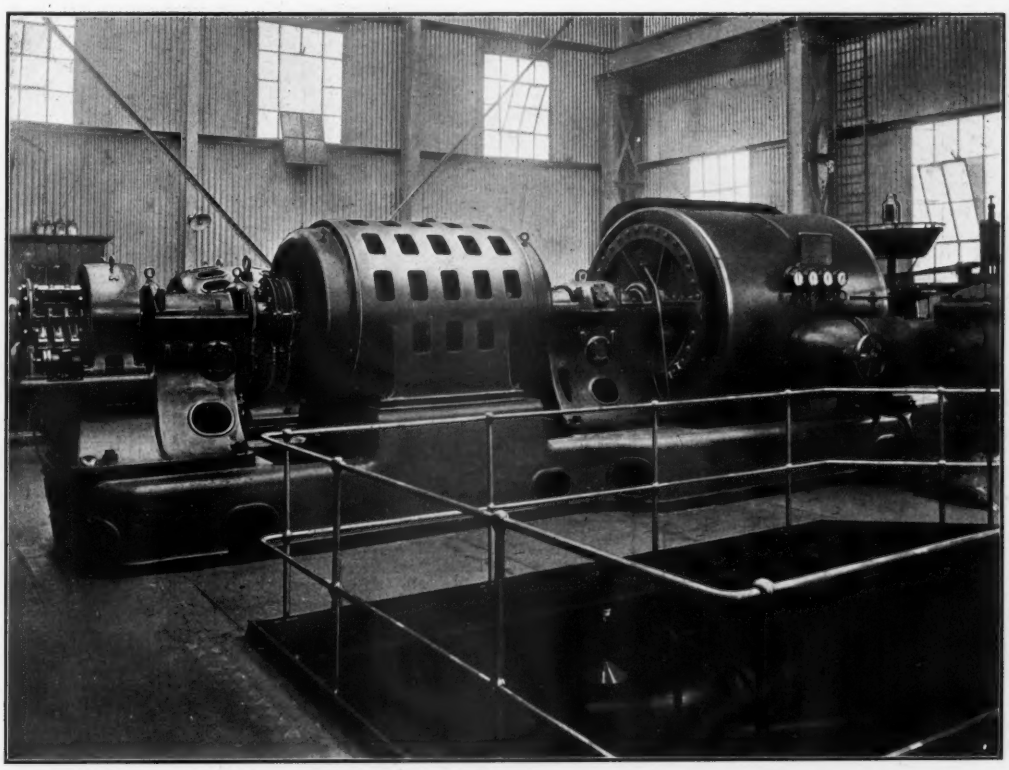
(*Continued on page 893.*)

AN EXHAUST STEAM POWER PLANT.

In his recent paper before the Iron and Steel Institute, Mr. C. H. Merz drew attention to the immense resources of the Cleveland and Durham areas in the shape of waste heat. He further showed what progress had been made in developing these resources, giving tabular statistics (Electrical Review, October 16th, 1908) in that connection.

Among the pioneer plants of this character is an exhaust steam power station at the Newport Ironworks of Sir B. Samuelson & Co., Middlesbrough. This company operates eight blast furnaces and produces a weekly average of 6,000 tons of Cleveland and hematite iron.

Through the courtesy of Messrs. Willans & Robinson, we are able to describe and illustrate the two exhaust steam turbines which they have recently put into operation at the above-mentioned power station, the turbines in question being of 1,350-kw. capacity each, and thus representing the largest exhaust steam turbines as yet set to work in this country.



Interior of Exhaust Steam Power Station, Sir B. Samuelson's Works, Middlesbrough, showing Willans Exhaust Steam Turbine Set.

The turbines in question are arranged for working with exhaust steam derived from three blowing engines, a turbo-blower, and a few exhausters.

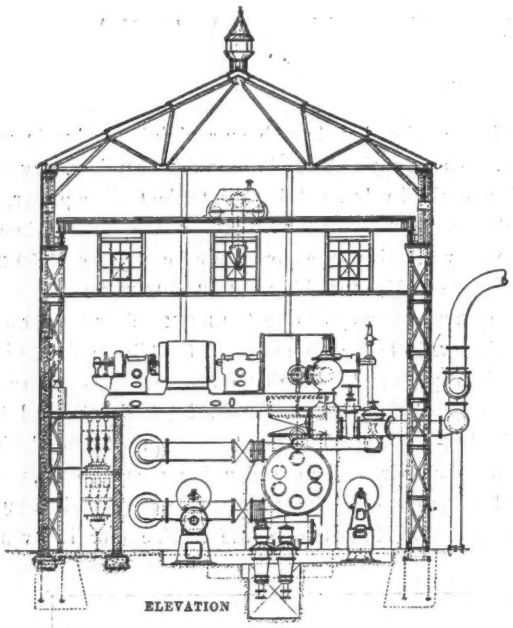
Above we give a view of the interior of the station, showing one of the turbines, and on the next page, the plan and elevation respectively of this installation.

The exhaust steam is carried through an overhead steam main of wrought-iron, 20 in. in diameter, up to the stop-valve, which is fixed outside the engine house. The steam then passes through two cast-iron branches to the two turbines, passing first through an equilibrium valve in each case, then through the main stop-valve strainer, governor valve, overload valve, and finally into the turbine proper.

The steam turbines are of Messrs. Willans' well-known exhaust type, and are rated for a normal capacity of 1,350 kw. each, and capable of working up to 2,000 kw. for eight hours when running at a speed of 2,400 r.p.m. They are normally supplied with steam at a pressure of 16 lb. absolute, which can be superheated through an independently-fired superheater (supplied by Messrs. The Stirling Boiler Co., and fired with blast-furnace gas) up to a temperature of 100° F. The turbines are arranged for exhausting each into a separate condenser, these being designed specially to maintain a 29-in. vacuum. An illustration of the turbine rotor is given on page 890, and from this it will be seen that the rotor, whilst of large diameter, is at the same time extremely short in length.

The condensing plant has been designed for maintaining a vacuum of 29 in. with the barometer at 30 in., the circulating water being fed at a temperature of 60° F. The air pumps discharge by gravity into a hot well let into the floor of the engine house in the middle of the condensing pit. Two electrically-driven centrifugal pumps deal with this water from the hot well and deliver it back to Messrs. Samuelson, through a Kennedy water meter, for boiler feed purposes.

The circulating water for the condenser is drawn from the River Tees, and delivered by means of centrifugal



Views showing Arrangement of Exhaust Steam Turbine Plant.

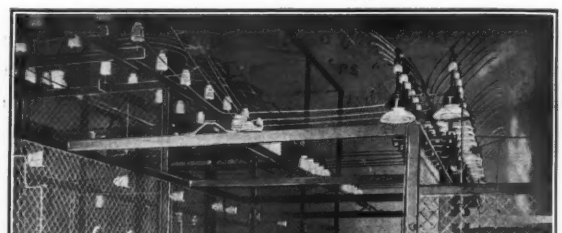
pumps, each capable of dealing with 10,500 g.p.m., situated in a pump house on the river side; one pump is therefore of sufficient capacity to maintain the necessary supply of water to the two condensers. The arrangement of the water pipes is such that a vacuum of between 15 and 20 in. can be maintained on the discharge pipe from the condensers to the river, this partly depending upon the state of the pipe.

The method of arranging the pipes has reduced the power required for pumping to a minimum, owing to the siphon action.

The electrical generators are of the three-phase type, capable of working at a pressure of 2,500 to 2,875 volts and 40 cycles per second, and are capable of giving their full output on a power factor of between ·7 and ·8. These alternators have exciters direct coupled to their shafts, which are arranged for working at 35 volts, this pressure being kept as low as possible, owing to the high speed at which the armatures revolve.

A further 700-H.P. high-pressure turbo-alternator is installed in the building, this being coupled to a range of high-pressure boilers, and exhausting into one of the above-mentioned condensers.

Oil switchgear, of the cellular type, is provided for controlling the electrical output of the plant.



Switch Chamber, Chilian Mining Power Plant (page 891).

The electric power derived from this installation is stepped up to 11,000 volts, at which pressure it is supplied to the network of the Cleveland and Durham Electric Power Co.'s system, and in this way this exhaust steam station runs in parallel with the Grangetown generating station of the above power company.

In the event of loss of exhaust steam therefore, or on account of other contingencies due to breakdown of the exhaust steam prime movers, the load can be immediately taken up by the high pressure turbines at Grangetown.

To obviate any possibility of stoppage of supply, the exhaust steam station here described has been fitted with a special signalling device, by means of which the engineer in charge can tell exactly what prime movers are in operation in Messrs. Samuelson's works, and whether any temporary closing down of any of them is anticipated, which would be likely to leave the turbines short of exhaust steam.

It is therefore improbable that the high-pressure steam

Rotor, Willans Exhaust Steam Turbine.

turbines at Grangetown would be likely to be called upon to supply a large amount of power unexpectedly, due to the shutting down of the exhaust steam plant. The two exhaust steam turbines in question have been installed for the Tyneside Electrical Developments Co. by their engineers, Messrs. Merz and McLellan, and the arrangement is that the Tyneside Electrical Developments Co. purchase the necessary exhaust steam from Messrs. Samuelson, and re-sell the electrical energy to the Cleveland and Durham Electric Power Co.

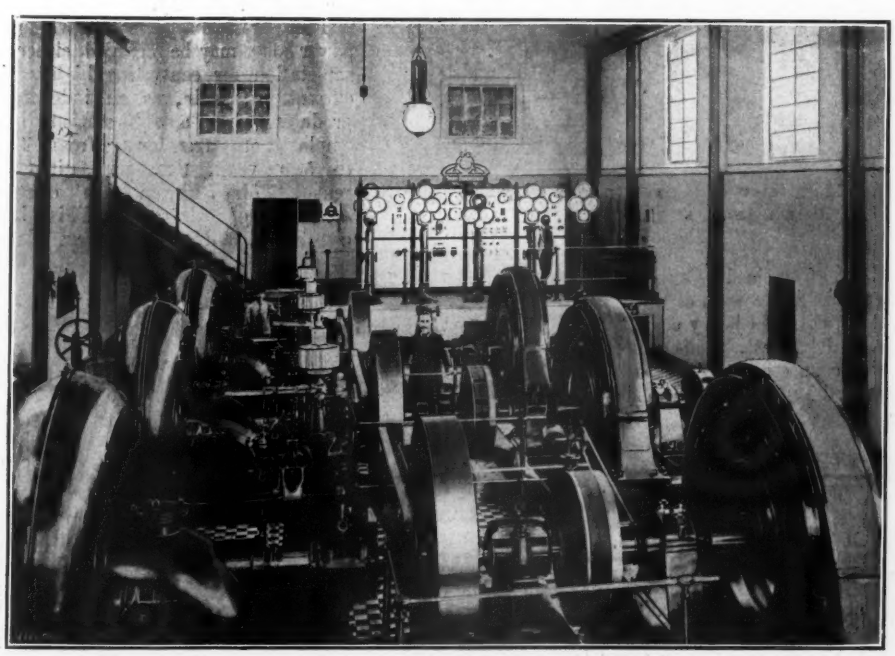
A CHILIAN MINING POWER PLANT.

[BY OUR BERLIN CORRESPONDENT.]

In a plant installed two years ago in one of the northern provinces of Chile, which once upon a time belonged to Bolivia, electrical energy is utilised for the extraction of saltpetre. The mineral from which the latter is derived, is found in a desert, arid district, below a stratum of some 10 ft. of rubble and gypsum. After being broken up by blasting or by means of steel wedges, the material is taken to the workshops for further treatment—viz., crushing and lixiviating in boilers, where the saltpetre, on the brine cooling down, separates in crystals.

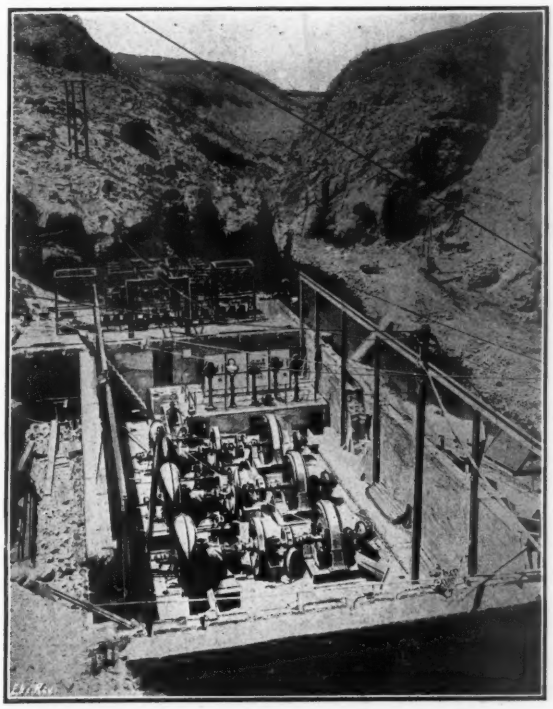
Owing to the special advantages likely to be derived under local conditions, from the use of mechanical operation in connection with this process of extraction, a hydro-electric power plant was erected on the Rio Loa, whence electrical energy was transmitted to one of the factories at 5,000 volts pressure. Originally a steam-generating plant operating with a transmission pressure of 2,000 volts, supplied energy to several other saltpetre factories; owing, however, to the considerable expense involved by the use of coal as fuel, the owners of those factories also eventually decided on utilising the water power of the river above mentioned, the more so as, according to estimates, the cost of erecting a hydro-electric power station was to be soon repaid by the saving of coal ensured by this means of operation.

The power house was installed at about 17 km. to the north of Rica Aventura, where the river, owing to steepness of its banks, is readily held up by a dam of relatively small length. From the embankment thus formed the water is supplied to the power station under a head of 25 m. to 30 m.



Interior of Power Station, Chilian Mining Power Plant.

The power house contains three 455-H.P. inward-flow Francis type turbines, each of which is coupled through an insulated coupling to a three-phase generator; a fourth set will eventually be added. Each generator is direct coupled to its exciter. Especially noteworthy in the construction of this power house was the fact that the machinery could be installed before erecting the outer walls and the roofing, any risk of the occurrence of rain being excluded by the climatic conditions of the country (see figure above).



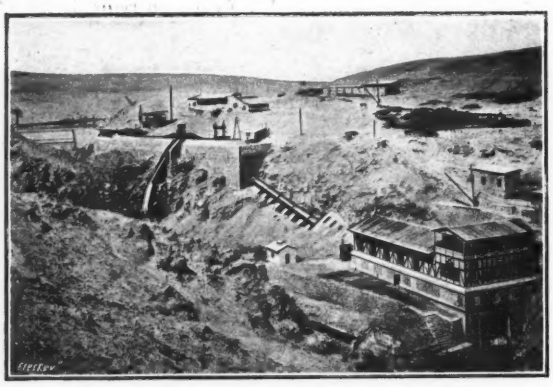
A Chilian Mining Power Plant, Erected in the Open.

In order to be able to use the steam-operated plant, above referred to, as a stand-by for the hydro-electric power plant, the generators of the latter were designed for the same pressure, viz., 525 volts, this being raised to 20,000 volts by oil transformers. The operating switchboard contains four marble panels, and five instrument pillars.

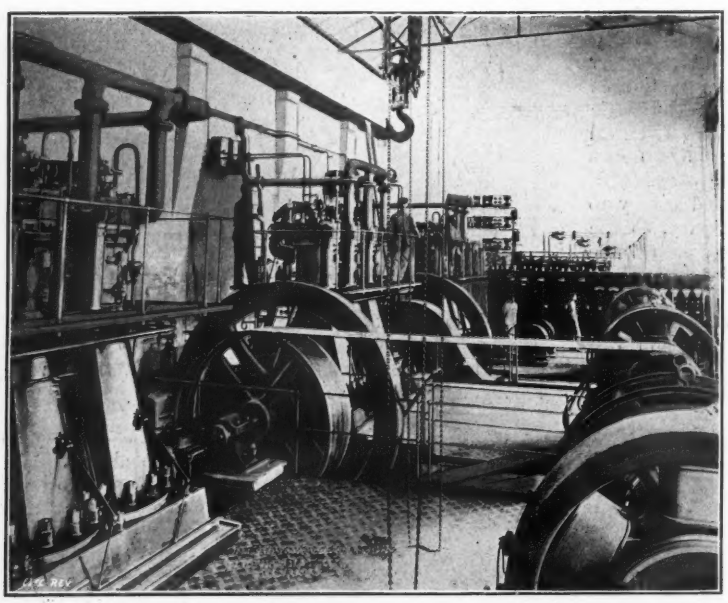
Three of the sub-stations erected at distances of up to 21 km. have been taken into operation, while a fourth is in course of construction at Prosperidad. The transmission lines, which in the first portion are 25 sq. mm., and in the last portion 16 sq. mm. in cross-section, are fixed to high-tension insulators, and carried by wooden poles of square cross-section.

The plant is protected against overload by time relays, which automatically interrupt the circuit by means of oil switches when the power exceeds a given limit. The oil

switches are remote controlled, the relay closing a low-current circuit.



View showing the Power House and Dam: Chilian Mining Power Plant (p. 891).



Caracas Tramways: Interior of the Power Station showing Diesel Engines.

An especially extensive system of overload safeguards has been provided to protect the plant against such disturbances as are likely to arise on the interrupting of heavy currents or in connection with atmospheric discharges. This comprises the choke-coils, which are connected to the ground over horn lightning-arresters and resistances, as well as a water-jet grounding device.

ELECTRIC TRACTION IN CARACAS.

A study of Venezuela and its progress industrially is not calculated to give one much satisfaction, or, indeed, benefit—and when one understands that the history of the country is also that of the Spanish Main, and that the revolutionary fever, although quiescent at the present time, is still existent, this is not surprising.

But even Venezuela's notoriously disturbed politics have not sufficed to prevent progress in some directions in its capital, Caracas, as well be gathered from the recent opening of electric tramways there.

Two small horse tramways have certainly existed in the capital for some time and apparently satisfied the needs of the 80,000 or so inhabitants—but an amalgamation of these companies in 1905, followed by a concession from the municipal authority for electrification, and aided by British capital, has resulted in a transformation.

The whole of this latter work has devolved on Messrs. J. G. White & Co., Ltd., who have reconstructed the lines of the old companies, and provided Caracas with some 10 miles of modern electric tramways.

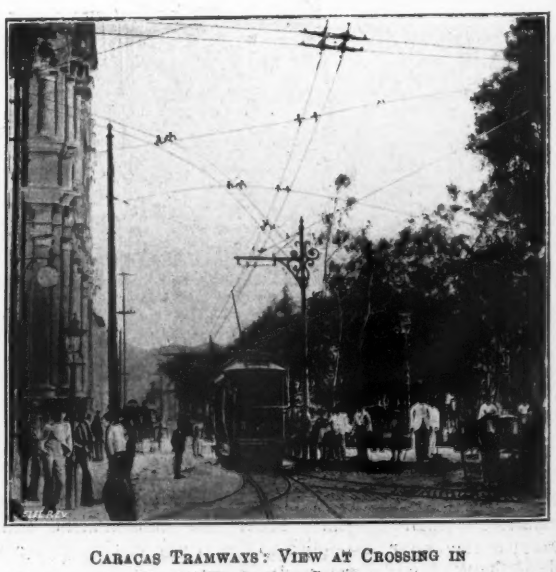
The principal line runs east and west, coupling the Central railway with the La Guaira Stations, and various branches run north and south from it, connecting to the suburbs, and, in the case of the Palo Gronde route, forming a connecting link to a chain of railways of uniform gauge stretching some 180 miles from Pto. Cabello, a rising port, to Valencia in the north.

The trackwork consists of 30-ft. rails, weighing 87 lb. per yard, of an American pattern, jointed with continuous rail joints, and laid on concrete stringers 16 cm. deep and 47 cm. wide, which are anchored every 15 yards.

The special work is of Hadfield's make, the points being all automatic; the rails are bonded with 4/0 B. & S. concealed bonds. The average Venezuelan has primitive ideas in regard to sanitation, and this somewhat hampered the otherwise good progress made in the road work, as the bulk of the drains are private property and laid with tile coverings about 1 ft. below the surface. The general run of the overhead work consists of side poles with cross bracket arms, tubular poles 30 and 31 ft. long being employed. These are partly of Grand National type and partly supplied by Messrs. Stewarts and Lloyds. Three Estler feeder boxes fitted with 250-ampere quick-break switches and 14 section boxes with 100-ampere quick-break switch are in use, and the trolley section is 2/0 B. & S., grooved.

A power house, car-shed—with five tracks, repair shops, &c., and office buildings occupy a rectangular site in the centre of the city.

There are two aspects from which the power house may be regarded, either as a sub-station for converting high-tension current, or, again, as an independent producer. As a sub-station it is employed to transform, from 4,500 to 500 volts, H.T. alternating current obtained from the electrical company of Caracas. This latter company has two stations at Encan-



Caracas Tramways: View at Crossing in Centre of City.

tado and Los Naranjos, about 16 km. from the capital. There are four generators at each station, and more machinery is now being introduced. The motive power is the water of the Guaira River, which has a fall of 38½ m. and 154 m. at Encantado and Los Naranjos respectively. During the day energy is supplied by the electrical company. In the evenings, however, when the town is lighted electrically, and also during stoppages, which may occur occasionally, the power is produced in the power house itself.

The power house equipment includes three 240-B.H.P. Diesel engines, which were selected partly on account of the high price of coal, and partly because they offered obvious advantages in rapid starting, in case of interruption of the H.T. supply.

The engines are belted to three 150-KW. motor-generators, working at 5,000 volts, three-phase, 50 cycles on the induction motor side, and, of course, 550 volts on the generator side—speed 500 R.P.M.

A 260-cell Tudor battery is also provided and works in conjunction with a Lancashire Dynamos Co.'s automatic reversible booster.

A 10-panel switchboard of G.E.C. (U.S.A.) make, provides for the control of both A.C. and D.C. plant; the same makers supplied the motor-generators.

As regards the traction feeders, these are all aerial and extend some four miles.

They are all of pure aluminium, ·33 and ·25 sq. in. section, supplied by the British Aluminium Co., and covered with triple-braided weather-proof insulation and compound.

For traffic purposes, 30 Milnes-Voss single-deck opensided cars have been provided, constructed of teak as regards framing and flooring, and with aluminium roofing.

The trucks are of the Brill pattern, supplied by the United Electric Car Co., each equipped with two 37-H.P. motors. Mechanical and magnetic track brakes, life-guards and destination indicators figure in the equipments, which conform to modern standards.

The whole of the reconstruction was carried out by Messrs. J. G. White & Co. so as to avoid interference with the normal traffic and little, if any, diminution took place in the Tramway Co.'s receipts during that period.

THE LONDON AND DISTRICT POWER BILL REJECTED.

On Wednesday the Select Committee of the House of Commons, which has for the last 15 days been considering this Bill, unanimously decided to report to the House that the preamble had not been proved.

Yesterday the Committee were to consider the Bills for linking up the existing supply systems, and we sincerely trust that some real advance will be made as the result of this consideration. It will be scandalous if, year after year, we both refuse powers to new authorities and withhold from existing suppliers the permission necessary to enable them to put their house in order.

NOTES.

(*Continued from page* 888.)

Prof. Ayrton's Funeral.—The interment of the remains of Prof. Ayrton, which took place on Thursday last week at Brompton Cemetery, was the occasion of a unique ceremonial, of impressive simplicity. There was a large attendance of Prof. Ayrton's friends, associates and students past and present. Anthems were sung at the graveside by a choir of boys, in pathetic compliance with the known likings of the dead, but there was no religious service. Prof. Perry delivered a brief oration, in which he dwelt upon Prof. Ayrton's disinterested devotion to work for the work's sake, his secret generosity, and his earnest endeavours to benefit the race. A laurel wreath from students of the Central Technical College was laid upon the coffin by Prof. Dalby, the Dean; and afterwards Mr. I. Zangwill paid a solemn tribute to the late Professor's love of justice, purity of motive, and ardent search after truth. Like the Americans whom he so greatly admired, he had "scrapped" the cumbrous mechanism of the body, but still energised through another and finer medium. The ceremony ended with the performance of Beethoven's Funeral March.

Institution and Lecture Notes. — Institution of Electrical Engineers.—The following awards, in connection with the work of the previous session, were made at last night's meeting of the Institution:—Salomons Scholarships, value £50 each, to Mr. Herbert Carnegie and Mr. Alfred Hutt; David Hughes Scholarship, value £50, to Mr. Clifford Higgins; the Institution premium, value £25, to Messrs. G. Stoney and A. H. Law, for their paper on "High Speed Electrical Machinery"; the Paris Electrical Exhibition premium, value £10, to Mr. J. S. Peck, for his paper on "Protective Devices for High-Tension Transmission Circuits"; extra premiums, value £10, to Mr. J. F. C. Snell, for his paper on "The Cost of Electrical Power for Industrial Purposes"; to Dr. A. Russell, for his paper on "Dielectric Strength of Insulating Materials and Grading of Cables"; to Dr. W. W. Haldane Gee, for his paper on "Electrolytic Corrosion"; and to Mr. T. M. Barlow, for his paper on "Heat Conductivity of Iron Stampings"; a First Students' premium, value £10, to Mr. H. R. Speyer, for his paper on "The Electrification of the Mansfield Copper Mines"; a Second Students' premium, value £8, to Mr. L. H. A. Carr, for his paper on "Electricity and Matter"; and three Students' premiums, each of the value of £5, to Mr. A. Hamilton, for his paper on "The Brown-Mackenzie System of Electric Block Signalling"; to Mr. H. W. Gregory, for his paper on "The Motor Converter"; and to Mr. P. C. Jones, for his paper on "Starters and Control Gear."

Rugby Engineering Society.—On October 15th the President, Mr. A. F. Bennett, delivered his inaugural address, the subject being the Progress of Steam Engineering, from the days of Trevithick to the present and future. The first conversazione of the Society was held on November 6th, and was attended by some 300 members and friends, who were received by the President. There was a most interesting collection of scientific apparatus and models, and the proceedings were enlivened by a musical programme, while short lectures on Geometrical Figures of Four Dimensions (E. B. Wedmore), Soap Bubbles (D. Potter and A. Dover), Astronomy (Lieut.-Col. G. M. Seabroke), Navigation (Com. H. G. Glennie), and Smoke Rings (G. M. Brown and F. Smyth) proved exceedingly popular. Indeed, the function, as a whole, was so successful and so highly appreciated that a similar conversazione will probably be organised at no distant date.

Institution of Electrical Engineers.—Newcastle Local Section.—On Monday last the chairman, Mr. A. L. E. Drummond, delivered his inaugural address.

Institution of Post Office Electrical Engineers.—On Monday last week, at a special meeting of the Institution, the Postmaster-General, Mr. Sydney Buxton, presented medals awarded to the authors of papers delivered in 1906-7. The Engineer-in-Chief, Major W. A. J. O'Meara, presided, and welcomed the Postmaster-General. He thought it would be a good thing if the Council instituted a special medal in each year for the solution of important problems which perplexed the department. Major O'Meara pointed out the assistance rendered by the electric telegraph in railway working, &c., and said that the desire of the Postmaster-General that Post Office engineering enterprises should be conducted on a commercial basis was welcomed by the Institution. Since the Post Office engineers had become responsible for their own accounting, the cost of maintenance of the telegraph system (which had risen from £617,616 in 1898-9, to over a million in 1903-4), had been brought down to £947,657 in 1906-7. Mr. Buxton, in presenting the four medals, congratulated the Institution on its achievements, and commented on the great interest which had been evoked by the various papers that had been received. The Institution would help the department to keep abreast of the times. The engineering work, which would be greatly increased when the telephone system was taken over, was growing more rapidly than they could secure additional staff, and many of the engineering staff were overburdened with work; a revision of the engineering branch was in hand.

The recipients of medals were as follows:—Senior Division: Silver medal, Mr. J. E. Taylor, for a paper on "The Propagation of Electromagnetic Waves"; bronze medal. Mr. J. G. Hill, for a paper on "Telephone Transmission." Junior Division: Silver medal, Mr. A. O. Gibbon, for a paper on "Underground Construction in the Provinces." Bronze medal, Mr. J. S. Brown, for a paper on "Post Office Lamp Signalling Trunk Exchanges." A vote of thanks to the Postmaster-General followed, after which a paper was read by Mr. F. L. Henley on the "Inspection of Wrought Timber."

Society of Engineers.—On Thursday last a conversazione was held at the Royal United Service Institution, Whitehall; the President, Mr. J. W. Wilson, M.I.C.E., and Mrs. Wilson received the guests, and an excellent musical entertainment was provided by the London Concert Orchestra and the Southwark Glee Singers, while the museum, full of service relics and curios, provided material of absorbing interest. The function was highly successful.

Royal Institution.—The eighty-third Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. William Stirling, M.D., LL.D., D.Sc., his subject being "The Wheel of Life." The course, which will be fully illustrated, commences on Tuesday, December 29th, at 3 o'clock, and will be continued on December 31st, 1908, January 2nd, 5th, 7th and 9th, 1909.

Institute of Metals.—The first annual meeting of the newly-formed Institute was opened at Birmingham last week. Sir William White presided, and there was a large attendance. The

Lord Mayor of Birmingham welcomed the visitors. In his inaugural address, the president said that the objects of the Institute were to afford a means of communication between members of the non-ferrous metal trades for matters dealing with manufacture, and generally to advance the knowledge of metals and alloys. The total membership was 260. Several papers upon technical subjects were read.

Institution of Electrical Engineers (Glasgow Local Section).—The seventh annual dinner of the Section was held on Tuesday last in the Grosvenor Restaurant. Mr. W. W. Lackie, chairman of the Local Section, presided over about 230 guests. After the loyal toasts from the chair, Sir John Urs Primrose proposed "The Imperial Forces," Engineer-Com. G. A. Hoggarty, R.N., and Lord Kingsburgh replying. Mr. Robert Caird, LL.D, toasted the Corporation of Glasgow, and the Lord Provost, Mr. M'Innes Shaw, in reply, said that in Mr. Lackie they had the right man in the right place. He advocated the combination of the electricity and the tramways departments. The supply of electric power to manufactories had been greatly augmented recently, and when the great electrical schemes of the Corporation and other bodies were put in operation, as they would be soon, the smoke nuisance would be entirely obliterated. "The Institution of Electrical Engineers" was proposed by ex-Bailie Willock, and in reply Mr. W. M. Mordey prophesied that before many years were over there would not be a factory chimney in Glasgow, and the citizens would be able to see the sky. So much coal was wasted in the production of electrical energy that the sooner their physicists enabled them to take the fuel energy out of the coal the better it would be. Major W. A. J. O'Meara, C.M.G., proposed "Glasgow Local Section," the largest of the local sections. In reply, the chairman said that the local section had been the means of bringing the electrical engineers of Glasgow and district into that close touch with each other which rendered them no longer incoherent units, but a combined force with common aims and common interests. The Local Section had now 280 members, and had an offspring in the shape of a students' section with 76 members. A musical programme was contributed by several artistes, and the evening was a most pleasant one.

Liverpool and District Electrical Association.—A Smoking Concert in connection with this Association was held at the White Bear Hotel, Dale Street, on Saturday evening, November 14th, when a very good programme was rendered by several of the members and their friends. The chair was taken by Mr. W. H. Hamilton, and during the evening some remarks were delivered by Mr. Samuel Frith, the hon. secretary and treasurer, as to the objects and principles of the Association, and extending a cordial invitation to prospective new members. The chairman also in the course of his address repeated the invitation to prospective members, and called upon existing members to do all they could to advance the Association.

Junior Institution of Engineers.—On Tuesday last Mr. J. Swinburne, the new president, delivered his inaugural address, the subject being "Available Energy."

Metallic-Filament Lamps: Price Reduction.—An important announcement in connection with the price of Osram lamps has been made this week, particulars of which will be found in our advertisement pages. We are informed that the manufacture of these lamps in this country has already commenced, and that an output of 15,000 a day is provided for.

The success of the tungsten lamp is too well-known to our readers to need demonstration; millions have been put on the market, and the high efficiency and extraordinarily long life of the lamp are beyond question—some have lasted even 6,000 hours without material deterioration.

The most noteworthy reduction is in the price of the 200-volt 50-c.p. lamp; it was not at first believed that this would secure a wide vogue, and its sale was not encouraged. The manufacturers, however, now recognise that it has come to stay, and station engineers will be gratified to learn that it has already become very popular, for it takes the place of the old 16-c.p. with practically no decrease in consumption. The experience of the gas companies with the incandescent mantle is in fact being repeated in this connection, and the electrical men have the advantage that the mantle has already paved the way to a higher unit of illumination. The reduction in price of the 50-volt lamp is also of importance. We have felt for some time that 25 volts was somewhat too low, often involving partial rewiring to cope with the increased current.

We do not wish to see a crazy war of prices, such as has crippled other branches of the industry; but we welcome the gradual and reasonable reduction of the price of lamps, which must greatly benefit the industry.

Electrical Football League.—On Saturday next a team selected from the different clubs connected with the League will journey to Leyton to play a selected team of the North-Eastern League. The match is in connection with the London Inter-League Championship, and a good game is expected. Those desirous of witnessing the match can obtain full particulars from the hon. sec., 39, Wearside Road, Lewisham. The kick-off is at 2.45, and admission 2d.

Last Saturday's Results:—At Willesden, Metropolitan Electric, 8 goals; Robertson's Lamps, 2 goals.

Next Saturday:—St. James' Electric *v.* Robertson's Lamps; at Wormholt Farm.

Football.—A match was played on Wednesday, November 11th, between the L.C.C. Sub-stations (Southern Section) and Southwark Borough Electrics. Result: L.C.C., 3; Southwark, 1.

Oxidising the Atmospheric Nitrogen.—In the Birkeland-Eyde process an electric arc is spread out into the form of a flat disk by means of a magnetic field. More recently the Badische Anilin and Soda Fabrik have employed thread-like arcs of great length for the same purpose. The arc burns in a tube of any suitable material, into which the air is blown tangentially so as to circulate spirally around the quietly burning arc. In some examples of this apparatus recently exhibited the tubes were of glass, coated on the inner periphery by a wire spiral which was in metallic contact with a knob at the top of the tube. At the bottom of the tube the wire spiral is only separated by a short distance from the other electrode, which is placed in the axis of the tube. When a 3,000-volt supply is applied between the two electrodes a spark jumps across and the arc travels rapidly up the tube. If, now, air is forced in at the bottom through a number of symmetrically placed tangential nozzles the arc burns quietly in the axis of the tube without touching the sides, and absorbs about 4 amperes at 3,000 volts. The air charged with nitrous gases which leaves the top of the tube gives up some of its heat in raising the temperature of the fresh air about to enter the tube to some 500° C., and the rest is employed in steam generation. The cooled gas is then mixed with water to form nitric acid, which after treatment with lime results in the required manuring material. An experimental installation on these lines was opened in Christiansand (South Norway) in the Spring of 1907 with a total power of 2,000 h.p. Three ovens are at work, with a length of flame of 5 metres, and each absorbing 600 h.p. An alternating current of 50 cycles is employed, and the arc burns quietly and reliably. The lower electrode burns away most quickly in spite of its being water-cooled. The Badische Anilin and Soda Fabrik has a working agreement with the Birkeland-Eyde Co. It is said that some 120,000 h.p. is about to be employed in this industry in Norway.—*E.T.Z.*, November 5th, 1908.

Army Contracts.—Replying to Mr. Pike Pease as to the total amount involved in the contracts for general stores and other manufactured articles secured by foreign firms during the past two years, Mr. Haldane gives in the Parliamentary Papers a long list of the value of manufactured articles so obtained in 1907-8, which include the following:—Carbons, electric light, £3; copper ingot, £82,877; disks, "Suherits," £51; machine tools, £3,361; telephones, £1,360. The total value of all such articles so obtained was £250,015, as compared with £325,584 in the previous year.

The Electro-Harmonic Society.—On Friday next week, in the King's Hall, Holborn Restaurant, a Ladies' Night Concert is to be held, with Mr. W. M. Mordey in the chair. The vocal items are to be rendered by the Misses Ethel and May Williams, Miss Mabel Braine, and Mr. Frederick Ranalow; Miss Gwendolen Mason will play harp solos, and there will be violin duets by Messrs. Spencer Dyke and T. E. Gatehouse. Other arrangements are:—Character sketches by Mr. Ernest Mills; humorous sketches by Mr. Ernest Hastings; and a performance by Mr. and Mrs. Arthur Marriott, technopathists.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. Horace W. Henderson, until recently at the Valley Road power house of the Bradford Corporation, sails from Liverpool this week to take up an appointment in Bengal.

General.—Mr. J. B. J. Privett, who has been engaged as resident engineer and clerk of the works since September, 1906, on the extension of the Metropolitan Railway Co.'s power station at Neasden, has now completed this work, and is leaving the company's service at the end of the year.

Mr. R. Martill Wilson has been appointed outside engineer for the Electrical Co., Ltd., for Scotland.

According to an American exchange, Cavaliere Alberto Faranda, director of telephones and telegraphs in Rome, has recently been in the States studying American telephone and telegraph methods for the Italian Minister of Posts, Telegraphs and Telephones.

We are quite sure that many of our readers will join with us in tendering our hearty congratulations to Mr. Geo. H. Verity (of Veritys Ltd.), on his nomination as a High Sheriff for the County of London. We believe that Mr. Verity is the first gentleman associated with the electrical trade to receive this particular distinction.

The death occurred on Sunday, at the Penlee Nursing Home, Walmer Villas, Bradford, of Mr. James Tate, electrical engineer, of Harris Street, Bradford. Mr. Tate was in his 63rd year.

NEW COMPANIES REGISTERED.

New Transport Co., Ltd. (100,245).—This company was registered on November 12th, with a capital of £11,000 in 10,000 preference shares of £1 each and £20,000 deferred shares of 1s. each, to acquire from A. W. Gattie, A. G. Seaman and H. Aldrich, the benefit of certain existing inventions for improvements relating to the loading, unloading, sorting, weighing, conveying and marshalling of goods, merchandise, chattels, books, documents, letters and the like, and to carry on the business of mechanical, electrical and magnetic engineers, manufacturers of apparatus, appliances, implements and machinery, &c. The subscribers (with one share each) are:—H. Aldrich, St. Margarets, Burgess Hill, merchant; A. W. Gattie, 13, Ladbroke Grove, W., engineer; F. H. Preece, 27, Clement's Lane, E.C., engineer; A. G. Seaman, The Narrows, Altrincham, Cheshire, electrical engineer; G. Cose, 17, Tower Royal, E.C., solicitor; C. Ashton Denyer, 17, Tower Royal, E.C., solicitor; G. H. Griffin, Meadowlea, Datchet, Bucks., merchant. Minimum cash subscription, £500. The number of directors is not to be less than two or more than seven; the first are A. W. Gattie, A. G. Seaman and H. Aldrich; remuneration as fixed by the company. Registered by Cox & Lafone, 17, Tower Royal, E.C.

Munster Electric Lighting Co., Ltd. (100,269).—This company was registered on November 14th, with a capital of £2,000 in £1 shares, to acquire the business of general electricians and contractors, electric light contractors, &c., carried on by J. Hunter, C. H. Wright, J. O'Keeffe, E. Griffiths, and R. H. Bindloss, as the "Munster Electric Co.," at Fethard, Tipperary. The subscribers (with one share each) are:—J. Hunter, J.P., 20, Fairfield Crescent, Liverpool; E. Griffiths, Linden Avenue, Blundellsands, Liverpool, engineer; C. H. Wright, Dale Cottage, Spital, Cheshire, engineer; F. Ley, 2, Abbey Road, Liverpool, cashier; A. Henderson, 26, North John Street, Liverpool, accountant; R. H. Bindloss, 26, North John Street, Liverpool, secretary and incorporated accountant; A. M. McVie, 1, Weldon Street, Walton, Liverpool, clerk. Private company. The number of directors is not to be less than two or more than seven; the first are J. Hunter, J.P., and E. Griffiths; qualification left blank in articles; remuneration as fixed by the company. Registered by Kerr and Lanham, 16, Furnival Street, E.C.

West Kent Electric Co., Ltd. (100,231).—This company was registered on November 11th, with a capital of £100 in £1 shares, to carry on the business of electricians, electrical, mechanical, metallurgical and chemical engineers, &c. The subscribers (with one share each) are:—W. A. Pittman, 10, Springwell Avenue, Harlesden, N.W., gentleman; A. G. Dobrantz, 22, Wakefield Street, Regent's Square, W.C., clerk; R. Hill, 32, Howard Road, Cricklewood, N.W., clerk; B. Bush, Glenross, Florence Road, Sanderstead, Surrey, gentleman; F. B. Bennett, 124, St. Mary's Road, Nunhead, clerk; A. S. Chetwood, 7, St. Helen's Place, E.C., solicitor; G. E. Bird, Chestnut Cottage, The Vale, Hampstead, N.W., clerk. Minimum cash subscription, £20. The number of directors is not to be less than two or more than seven; the first are P. H. Martin and G. E. Bird; qualification, £10; remuneration as fixed by the company. Registered by Minet, Pering, Smith & Co., 7, St. Helens Place, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,997).—Particulars of £250,000 second debentures created by resolution of February 15th, 1906, have been filed pursuant to Sec. 10 (3) of the Companies' Act, 1907, the amount of the present issue being £1,500. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Edmundson's Electricity Corporation, Ltd.—This company's annual return was filed on September 18th, when the entire capital of £800,000 in £5 shares (80,000 preference) had been taken up. £5 per share has been called up on 66,800 ordinary and 80,000 preference shares, resulting in the receipt of £734,000. £66,000 is considered as paid. Mortgages and charges: £572,000.

Jandus Arc Lamp and Electric Co., Ltd.—This company's annual return was filed on October 20th, when 2,041 shares had been taken up out of a nominal capital of £30,000 in £10 shares. £5 per share has been called up on 1,195, and £10 per share on 250 shares, resulting in the receipt of £8,475. £5,960 is considered as paid. Mortgages and charges: £5,144 2s.

D. Santoni & Co. (1906), Ltd. (89,277).—Mr. H. G. Nordalys ceased to act as receiver and manager on October 31st, 1908, and has filed accounts from November 30th, 1907, to October 31st, 1908, showing repayment of £4,936 to debenture-holders on account of £4,950 capital.

CITY NOTES.

London Electrobus Co., Ltd.

Six months ago this company offered the public £240,000 ordinary shares, each application for 20 shares carrying the right to apply for one deferred, which was to share generously in the future profits. Previously £60,000 had been issued. We do not know how much out of that £240,000 was forthcoming, but in the ELECTRICAL REVIEW of June 19th we had occasion to criticise a broker's circular, in which every applicant for 10 shares received a deferred share as a bonus without payment. Now we have before us some circulars that have been issued by the board to existing shareholders, offering them £50,000 first mortgage debentures at par, the interest being as high as 6 per cent. These debentures are "exchangeable for ordinary shares" during three years, and they are offered first to the existing shareholders, who should by now have formed some estimate of the probable value of their holding as an investment. In the event of their not desiring these debentures they are to sign "the enclosed form of renunciation," "so that the board may dispose otherwise of the debentures." We understand that the company has 20 electrobuses, the average in service being 13½ for the three months ended October, 1908, but we are informed that "the directors cannot put more 'buses on the road without further capital, and this, in their own interests, the shareholders should supply." We are actually informed that "the property of the company will be increased by the use of the money subscribed," which seems a very unnecessary statement after that given above. "The debentures *should be* absolutely secured, because not only will all the present property of the company be charged, but the 'buses, &c., purchased by the moneys subscribed will become subject to the charge." This makes us wonder whether all that has gone before is insufficient in value to cover the £50,000 debentures adequately. We cannot help a sickly smile as we think of that 10 per cent. dividend on the ordinary shares, and 100 per cent. on the deferred. Everything seems to us to point to the last issue having been severely neglected by the public, and to the company being now in urgent need of money to enable it to make any progress at all.

We are sorry that this appears to be the capital position of the company, for we like the Electrobus, and all its good qualities as an electrical vehicle, and it is clear that the public also do so from the patronage that they extend to the vehicles (while the cheaper fares are in vogue) on one of the best routes in London, but we are afraid that after the financial ways that have been adopted in its exploitation, there will be no eagerness to find more capital until there is something like a reasonable prospect of commercial success. And here we naturally turn to the figures of working costs and receipts that are furnished with the appeal for more capital. For the period July, 1907, to October 15th, 1908, the average takings have been 14d. per 'bus-mile, and for the last three months of that period the 'buses in service earned a gross profit at the rate of £448 per 'bus per annum. Would the same rate be easily earned with a quadrupled service operating on other routes? The total income for the three months is given as £5,007 (14·33d. per 'bus-mile), while the total operating cost is stated as £3,480 (9·99d. per 'bus-mile), leaving a gross profit of £1,526 (or 4·39d. per 'bus-mile), but this statement does not include any provision for establishment, supervision or head office charges, or repairs to buildings; the total of these it is said, was £1,517, *excluding depreciation*. So that with the present 'buses during the three months the ends have been made to meet, with the exception of depreciation. It is stated that the "establishment and overhead expenses," which are about £6,000 per annum, would not be materially increased if the fleet were doubled—as a matter of fact, it is proposed to quadruple it. From reading these circulars it seems that you have only to go on adding indefinitely to your number of vehicles, and you will not only reduce your losses, but will find a profit, because if you had 80 'buses running, each earning a gross profit of £448 per annum, you would have an income of £35,852, which would enable you to provide £6,000 for your establishment and overhead charges (stationary), debenture interest £3,000, provision for depreciation and amortisation of debentures £14,000 leaving available for dividend on those ordinary and deferred shares £12,852. If the present debentures are subscribed for, the fleet will, when the money has been spent, total 80 'buses; and reckoning at the outside about £1,000 apiece (a very liberal estimate seeing that both batteries and tires are hired), the present debenture should have as security £80,000 (less depreciation) in the form of 'buses, plus the garage, &c., and anything that may remain unpaid on the share capital.

The following is the statement of the auditors concerning the business of the company down to date:—

15, George Street, E.C.,
November 12th, 1908.

To the directors of the London Electrobus Co., Ltd.

Gentlemen,—We have examined the books, accounts and other records of your company for the 15 months ending October 15th 1908, and certify that for the year ending July 15th, 1908:—

The number of passengers carried was	1,596,831
The total receipts were	£8,727 12 9
The average receipts per 'bus-mile were	19·8d.
The total operating expenses were	£7,984 14 7
The profit on operating for the year was	£742 18 2

And we further certify that for the three months ending Octobe 15th, 1908:—

The average daily mileage of the 'buses in service was	67·2
The number of passengers carried was	925,959
The total receipts were	£5,006 16 10
The average receipts per 'bus-mile were	14·39d.
The total operating expenses were	£3,480 8 1
The average operating cost per 'bus-mile was	9·99d.
The profit on operating for the three months was	£1,526 8 9

The following is a detailed statement of the receipts and operating expenses during that three months:—

Income.			
Traffic			£4,856 19 3
Advertisements			149 17 7
			£5,006 16 10
Per 'bus-mile, 14·88d.			
Expenditure.		Per 'bus-mile.	
Drivers' and conductors' wages, including bonuses		2·87d.	£1,000 18 5
Wages of washers, cleaners, lift and yardmen		·41d.	129 0 3
Accumulator hire		1·99d.	695 7 10
Tire hire		1·69d.	588 8 9
Power, excluding "forming expenses"		1·05d.	368 7 3
Power wages		·10d.	35 15 0
Repairs to rolling stock and plant		·48d.	168 14 6
Wages on same		·29d.	103 0 1
Rates, taxes, rent, gas and water		·49d.	170 16 2
Garage, clerical wages		·07d.	26 19 0
Licences		·05d.	18 0 0
Insurance		·42d.	144 0 0
Accidents		·05d.	17 11 8
Punches and tickets		·03d.	9 6 8
Printing		·01d.	4 2 6
Total operating cost		9·99d.	£3,480 8 1
Profit		4·89d.	1,526 8 9
		14·88d.	£5,006 16 10

The stores and material on hand at October 15th, 1908, have been valued by the company's engineer and officials, who have also allocated the expenditure, which allocation we have adopted.

The above statements do not include any provision for establishment, supervision or head office charges, nor repairs to buildings, but the total of these, excluding depreciation, for the three months ending October 15th, 1908, was £1 516 11s. 7d.

THOS. J. GARLICK & Co.,
Chartered Accountants.

The annual meeting is to be held next month, the directors having resolved to close the financial year at October. The balance-sheet is not ready, and pending its completion, the directors have prepared the two circulars that are now before us. We must confess that, if we desired to invest in the undertaking, we would rather wait and see that full balance-sheet before taking a share in the present issue, much as we may wish the Electrobus success in the interests of electric 'bus traction.

West India and Panama Telegraph Co.

MR. W. B. KINGSFORD (chairman) presided on Wednesday at Winchester House, Old Broad Street, E.C., over the sixty-third ordinary general meeting of the above company.

In moving the adoption of the report and accounts (see ELECTRICAL REVIEW, November 3rd, page 856), the CHAIRMAN said the total receipts for the half-year amounted to £39,733 against £43,832, a decrease of £4,099. Of that decrease £2,253 occurred in traffic receipts. He would like, however, to remind them that in the corresponding period of last year their receipts were augmented owing to the heavy Press and other traffic exchanged in consequence of the earthquake in Jamaica. In addition to this they further benefited in the corresponding half-year from earnings of a special nature also arising from the same cause. In fact it was almost entirely owing to the circumstance that they were comparing with a period during which abnormal conditions prevailed that the receipt for the half-year showed the falling off he had mentioned. Passing to the expenses side of the account, they would notice that these were £27,567, as compared with £30,028, or a net reduction of £2,461. This reduction was chiefly due to their having expended considerably less on cable repairs than they did in the June half of last year. In the corresponding half of last year they also incurred a special expenditure of £1,191 in connection with the Jamaica earthquake—which was an expenditure which happily had not recurred this year. On the other hand, there had been an increase in the cost of working the 21 stations, amounting to £935. Of this, salaries and wages and subsistence allowances accounted for £603. The latter item was shown separately for the first time, which they considered was a better plan than merging it under the heading of salaries and wages. Those allowances were only granted where the local conditions were such that some assistance of the kind from the company became a necessity. The balance of the increase was spread over various items, notably that of medical attendance, which had been very heavy. He ought to tell them that the traffic receipts for the current half-year up to the middle of November had fallen below the receipts up to the same time last year. He was quite unable to suggest any special reason for the falling off, but it appeared to be simply due to a discontinuance of the general activity in trade which brought them in their larger receipts in the second half of last year. They had undertaken to establish wireless telegraphy between British Guiana and Trinidad. As the shareholders were aware, they had always had great trouble in maintaining uninterrupted communication between those two Colonies, owing to the rapid deterioration of the cable caused by the highly corrosive nature of the ocean's bed in that region. Under those circumstances they had offered to establish wireless telegraphy between those colonies which they hoped would prove a useful adjunct to the existing service. The necessary plant for the installation would be shipped from London the following day. Considering how largely for some time past the value of securities had generally depreciated and injuriously affected the invested reserve funds of many companies, it was very satisfactory to find that their investments showed only the comparatively small depreciation of about 4 per cent. on their cost. He concluded by moving that a dividend of 6s. per share be paid on the first preference shares, and a payment of 12s. per share on account of dividends accrued to June 30th on the second preference shares.

MR. H. HOLMES seconded the motion.

In reply to questions, the CHAIRMAN said the falling off in the receipts in the current half-year was between £3,000 and £4,000. The wireless telegraphy installation would cost between £5,000 and £6,000. The board had not yet definitely decided how the cost would be met, but he thought it should hardly be paid entirely out of revenue.

The report was then carried.

British Columbia Electric Railway Co., Ltd.

THE twelfth ordinary general meeting of the shareholders of this company was held on the 12th inst., at the Great Eastern Hotel, Liverpool Street, Mr. R. M. Horne-Payne presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, Nov. 13th, p. 856), said that for the eleventh time in succession the board were able to meet the shareholders with an entirely satisfactory report and balance-sheet, with the record of a year successfully passed, and with every hope of continued success in the future. He could assure them without hesitation or reservation that the directors did not know of a single cloud in the outlook, and that every indication pointed to increasing trade and prosperity for British Columbia, and for the company. There was only one item in the balance-sheet that required any explanation, and that was the large increase in the value of supplies on hand. This was due entirely to the fact that they availed themselves this spring of the panic prices of copper, steel and other supplies to make purchases in advance for some eighteen months or two years, and a considerable part of the amount under the heading "creditors" was also due to similar purchases of supplies which had not been actually delivered on June 30th. A very pleasant and important feature of the report was the paragraph which referred to the concessions granted to the company to carry on its business for a long period of years in almost all the municipalities adjacent to Vancouver and New Westminster. Before such concessions as these could be granted in Canada, they must be voted upon by the tax-payers, and that these tax-payers, after a long experience of the policy and methods of the company should, by large majorities, grant them these concessions for such long periods was the strongest possible endorsement of the good standing and popularity of their enterprise and its management locally. Referring to recent criticisms which had appeared in the Canadian Press in reference to the policy of encouraging British capital in the Dominion, he said that their company had been in existence 11 years, and during that time it had invested over 11 million dollars on which they had paid 5·66 per cent. in interest and dividends. It had needed a good deal of courage to invest such large sums, and a good deal of patience had had to be exercised to reap a reward, but he had no hesitation in saying that the cities would not have prospered as they had done if it had not been for the money that their company had put into the country in its railways. The first thing that was essential to the success of such a company as theirs, from the standpoint of the public as well as that of the shareholders, was a long lease of life on fair conditions, such as they now reported; it was absolutely impossible to achieve any success unless an undisturbed existence of at least 40 years was guaranteed, because it was impossible to raise money on reasonable terms, and with less than 20 years to run it was next to impossible to obtain money at all, so that a 40-year concession did not mean free and unrestricted development for 40 years, but only for about 20 years. There was not the least doubt that the longer the concession the better for all concerned, because the longer the concession the less it cost to borrow money. They wanted British Columbians to understand, and he thought they had shown that they did understand, that they were their partners in prosperity and in adversity; that their every interest was their interest, and that they would share up the profits of the partnership fairly. Let them continue to help them in every way they could, and the company would continue to help them liberally and on broad lines by every means in their power. Canada as a whole had emerged from the period of depression that he had to record at last year's meeting, and had emerged from it stronger than ever. It was possible that the time might come when they would learn that mistakes had been made in Canada as in other countries, and that money could be lost, as well as made, there. When this occurred, he hoped they would remember that nothing great could be achieved without mistakes, and that in the building up of perhaps the greatest of all enterprises, the great and wonderful Dominion of Canada, mistakes were bound to be made and set-backs to occur. If some other Canadian undertakings should fail, he asked them not to lose confidence in their company or in the country, and not to throw away their good securities with the bad ones, but to take each investment on its own merits, and if they had doubts, seek out the advice of those who were well acquainted with the country, and who, as directors or otherwise, had done well for them in the past, and had established a definite claim on their confidence by a successful record.

The HON. R. G. TATLOW (the Canadian Minister of Finance), in seconding the resolution, said that during the past year British Columbia had passed through one of the most stringent times it had ever been called upon to meet, but he was glad to say that it had felt it less severely than probably any portion of the American continent. Under those circumstances, it was all the more satisfactory to know that their company had been able to do a largely increased business. As to the future, they had the right to run through the delta of Fraser River—considerably over half a million acres of the richest alluvial land in the province, which was now thickly settling up with market gardens and dairy farmers, so that very shortly there would need to be opened up not only one, but a series of electric lines. Beyond that, they had the great Chilliwack

Valley, in which they were now building their railways, which went through one of the best pieces of land in British Columbia. They had also a very valuable concession of some 11,000 acres of land, which they all believed would in a few years, when thoroughly reclaimed, more than repay the cost of the construction of the road they were now making. In Vancouver the prospects were as encouraging as they ever had been. The Grand Trunk Pacific Railway had announced that it intended to build a branch line to that place, which meant that all the trans-Continental traffic must pass through Vancouver. People in England could not be too careful to look very carefully into any concessions which were granted to them in order to see that they obtained what they bargained for.

The report was adopted.

An extraordinary meeting was subsequently held, when a resolution was agreed to, increasing the capital of the company to £1,800,000 by the creation of 300,000 new shares of £1 each.

Lancashire Power Construction, Ltd.

Mr. T. O. Callender presided at Winchester House, Old Broad Street, on the 11th inst., over an extraordinary general meeting of the above company for the purpose of considering, and if thought fit, passing the following resolution:—"That the articles of association of the company be altered by striking out the existing articles 7, 8 and 9, and by substituting the following new articles therefor," that is to say:—

Article 7.—The company shall be at liberty to create income stock to an amount not exceeding £150,000, conferring upon the holders the right to have distributed among them in proportion to the amounts of income stock held by them respectively a sum equal to three equal fourths parts of the net profits of the company of each financial year. Such net profits shall be ascertained after deducting all outgoings, interest on debenture stock and debentures and other borrowed money, and all trading and administrative expenses, and after making a proper allowance for depreciation, and after deducting any sum carried to reserve, but without deducting any sum carried forward, and to be distributed within one calendar month after the date of the holding of the ordinary meeting of each year. Such income stock shall, as regards payment, be postponed in the event of the winding up of the company to the other debts and liabilities thereof, and to the costs and expenses of the winding up. The company may issue such income stock by way of commission to persons subscribing for the proposed issue by the company of debenture stock for £150,000 at a rate not exceeding 100 per cent. of the debenture stock subscribed by each subscriber for debenture stock.

Article 8.—The registered holders of the income bonds shall be entitled to have notice of and to attend and vote in person or by proxy at all general meetings of the company. Each registered holder of income stock present in person at any general meeting shall on a show of hands be entitled to one vote, and on a poll each such holder present in person or by proxy shall have one vote for every £1 of the income stock held by him. At any such meeting three holders of income stock personally present may demand a poll. Subject as above-mentioned, all the provisions as to notices of meeting and voting thereat, and as to the appointment of proxies and attornies contained in these articles, shall *(mutatis mutandis)* apply to holders of income stock in the same manner as if they were registered shareholders of the company, but any holder of income stock may appoint another holder thereof to vote as his proxy at any general meeting.

Article 9.—The "A" and "B" shares shall rank *pari passu* as regards distribution of profits, but in the event of a return of assets or a winding up, or otherwise, the assets of the company remaining after paying its debts and liabilities, including the amount represented by the income stock, shall be applied in the first place in payment to the holders of the "A" shares of the company of the amounts paid up or credited as paid up on the "A" shares held by them respectively, and in the second place in payment to the holders of the "B" shares of the amounts paid up or credited as paid up on the "B" shares held by them respectively, and any assets remaining undisposed of after making such repayments as aforesaid shall be distributed amongst the members of the company in accordance with the number of shares (without any distinction between the different classes) held by them respectively.

The Chairman said that in July they called the shareholders together to make certain arrangements with reference to the finances of the company, and the scheme then laid before them was carried. The response of the "A" shareholders was, however, very disappointing, for instead of obtaining the £90,000 which they anticipated from them, they only received £35,950 in application. The "B" shareholders applied for £55,880 out of the total of £60,000, which was their quota. Under those circumstances, therefore, instead of having £150,000, they found themselves with only £91,000, the greater portion of which had been provided by the "B" shareholders. The scheme submitted in July was contingent on the full £150,000 being raised, and consequently it was found impossible to carry it through, and it became necessary to find another method of raising the money which was required to bring the company into the position which they had every reason to believe it would soon attain to under proper management and with proper resources. As a result, the position had once again to be considered, and meetings of the directors and the committee were held, and a revised scheme was adopted, which was fully described in the resolution. It might be said that the price to be paid for the new capital was high. That was so, but it was necessary, in view of the poor response to their previous proposals, to increase the inducements to shareholders and others to take part in the new issue. They had only arrived at the terms put forward that day after many endeavours to do something better, and they had satisfied themselves that the money could not be obtained except on these terms. At the same time it must be borne in mind that this new issue, with the contingent rights, was being offered to existing shareholders in proportion to their holdings, and so by taking his quota any shareholder could protect himself. In order to make it quite clear, he intended at a later stage to propose an amendment that the words "income debenture stock" be substituted for the words "income stock" and "income bonds" which appeared in the resolution. They wanted to make it quite clear that it was not an increase of capital but debentures which they were raising.

Mr. Gripper seconded the motion.

Mr. F. Dore asked whether it was not a fact that the directors took power to raise a further £150,000, and if so, on what terms; why the directors of Edmundson's Electricity Co., Callender's Cable Co., and the British Thomson-Houston Co. were not called upon to take up £12,500 of the "B" shares; how much did Mr. Parshall receive for his first estimate, and how much would he receive for his second estimate; and did he accept the responsibility of the utter failure of the company which after expending £400,000 in five years could only show a loss of £10,000; were the directors of the promoting companies prepared to return the £4,700 they had received as fees, and the brokers to return the £3,200 they had received in order to help their unfortunate clients; why had the provision that the "A" shares should receive a preferential dividend of 5 per cent. before the "B" shares been cancelled; and why had Mr. Wolfenden retired from the board?

Mr. Phungst said the "A" shareholders were really the only people in the company who were disinterested, for everyone else had come in to get something out of it. The "A" shareholders paid their money down on the faith of Mr. Parshall's estimate, and on the strong recommendation of the official brokers. Mr. Parshall's estimate had so far proved not only misleading and unreliable, but it was absolutely self-condemned by his second estimate. The first estimate promised plant and machinery and a concern for £295,000, including all contingencies, and including even £7,500 working capital, and that this would put them into the position of earning £22,000. Now they were promised £18,000 with a capitalisation of £600,000. The only item which had been substantiated in the original estimate was the sum to be paid to the consulting engineer, which was fixed at £12,200, and which had proved to be £12,450. The first cash went to pay Edmundson's, and they had had their bit. The fact was, that the "A" shareholders had lost their money, and would do better to refuse the scheme. He believed they could get £100,000 for the concern, and that would give the "A" shareholder £2 a share back.

Mr. Durlacquer complained that, although a large shareholder, he had never been called in in any consultation. He had no interest in any of the promoting companies, but no one except the original clique had been consulted. It was all very well to talk about trust companies putting up money, but they put up the money of other people, whereas he and others were asked to put up their own money.

The Chairman said they had already passed a scheme for raising the necessary money on terms much more favourable to the "A" shareholders than those proposed that day, but the "A" shareholders had allowed matters to drift, and had it not been for the creditors waiting for their money the company would now have been in the hands of a Receiver. There were no debenture-holders, and in the event of trouble arising, it would be the creditors who would be top dog. If they did not accept the scheme forthwith, the creditors would take the necessary steps to put themselves in possession of the concern. The directors took power under the scheme to raise a further £150,000, but did not intend to raise it at present. When the time came he took it they would raise the money on the same terms. The taking up by Edmundson's, Callenders, and the British Thomson-Houston Companies, of £12,500 "B" shares, was conditional on their claims being paid in cash, and that with other things, was cancelled owing to the "A" shareholders not finding them quota. Mr. Parshall received 2½ per cent. on the work carried out. He considered the question about Mr. Parshall was put in a very unfair way. At previous meetings they had explained the difficulties which had been put in the way of developing the business owing to the hostility they experienced at the hands of nearly all the local authorities, and it had taken years to get into the friendly relationship in which they found themselves to-day. The fact that the present directors were the directors of the promoting companies, was not their fault, for other gentlemen had retired, and left the burden of carrying on the company to them. He could say nothing as to fees, without consulting the other directors. The cancelling of the provision that the "A" shareholders should receive a preferential dividend of 5 per cent. was part of the bargain made with the "B" shareholders when the "A" shareholders would not find the money. Mr. Wolfenden retired through ill-health.

Mr. Collis, as a member of the Committee, said that they had devoted many months of work to the company's affairs, and they would not consider any further scheme.

Mr. Parshall said that with regard to the criticisms made upon himself, he was retained to design a power installation to give certain results, and there had never been any suggestion that the installation was not capable of doing all that he had promised. Because the company had a defective Act of Parliament, that was no business of his. It was that, however, which they had suffered from and which had handicapped them.

The resolution, as amended by the Chairman, was then agreed to.

The A.E.G., of Berlin.

The business year 1907-8 has resulted in another increase of profits of the largest electrical undertaking on the Continent. The figure given for the net profit is 15,931,211 marks, as compared with 14,868,175 marks in the previous year. However, the published balance-sheet does not make quite clear what total profits have been actually obtained, as all profits from financial transactions are being kept secret, and are used for special depreciations, which are not specified either. The figure given for the gross profit is 17,835,744 marks, as compared with 16,484,939 marks in 1906-7. This increase is the more remarkable as a considerable part of the business year came under the head of the industrial decline. The value of orders in hand when entering the new business year is said to be equal to the corresponding amount of the year before. Some other items are as follows:—Administrating expenses (less

amount paid by Berlin electricity works), 467,523 marks (584,591 marks previous year); rates and taxes, 1,286,986 marks (946,009 marks previous year); dividend (12 per cent.) 12,000,000 marks (same as last year); bonus of board of trustees, 400,000 marks (same as last year); bonus of employés' and pension fund 2,200,000, (1,200,000 previous year). Regarding the different factories the report is, on the whole, satisfactory. The machine factory supplied 1,161,060 H.P., as against 1,350,327 H.P. in the year before; the turbine works supplied in addition 731,000 H.P., this being 570 turbines. The paragraph, "Cable Works Oberspree," is of special interest on account of the important decrease of the price of metal. This is what the report says: "We think that the decrease of the prices of the produce in the cable works on account of the reduced cost of raw material amounts to about 10 million marks. However, as the turnover is only 7½ million less, it means that the works have produced over 2 million more. This is corroborated by the consumption of copper amounting to 20,187 tons, a figure never reached before. The orders for high-tension cables have been much more frequent, and the enamelled wire which we have put upon the market some time ago seems to come more largely in use. The sale of paper tubes, and the newly introduced line of copper and brass tubes show a satisfactory development." The report does not state how the motor-car factory of the firm is getting on; it is only pointed out that the motor-car industry is not in a flourishing state yet, and that the utmost care in the sales and a considerable restraint in the production are imperative. The report goes on to say: "It may take years before motor-cars for sport or luxury are again as much in favour as they used to be." Regarding the erection of central stations, the report states: "During the previous year we erected, apart from the many structures built for the Berlin electricity works, 70 central stations or additional plants of a total of 153,450 H.P. (95,150 H.P. the previous year). The length of cables laid for these new stations is 1,823 km. (1,600 km. the previous year). There are 67 central stations or additional plants in course of erection, having a total of 203,225 H.P. (106,315 the previous year), and a length of cable of 769 km. We paid special attention to high-tension work, including the manufacturing of the apparatus used for same, and are able to point to many successful plants of this description. To mention some, there is the 40,000-volt plant for the Victoria Falls Power Co., the central station on the Pleisse for 30,000 volts, the plant of the province of Silesia for 10,000 and 30,000 volts. The plants of the Sydsvenska Kraftaktiebolaget are designed to be worked with 54,000 volts." About electric traction, the following is said: "We have received inquiries about converting steam-driven into electrically-driven railways according to the system used in Hamburg, from nearly all German State railways and many foreign railway companies. At present we are engaged in working out the designs. We have received an order for 19 accumulator cars for the Prussian State Railway, intended to enable a denser passenger traffic on lines not fully charged and for the suburban traffic of towns of medium size. Further orders of this kind will be placed later." The number of employés was 32,035 on July 1st, 1908. The report does not mention anything as to the probable effects of the intended tax on electricity.

The Berlin Electricity Works.

THE report for 1907-8 of the directors of the Berliner Elektrizitäts Werke, which have a practical monopoly of electric light and pwoer supply in Berlin, first refers to the increases in the share and other capital during the financial year, and to the acquisition of 93 per cent. of the shares in the Electricity Supply Co. It is then mentioned that the number of new connections increased during the year, the expansion having been greater than in 1906-7, and the profits experienced a further advance. The dividends now proposed, which are the same as in the preceding year, only relate to ordinary share capital amounting to £1,575,000, and preference shares totalling £500,000, the balance of capital in each case not yet being entitled to participate in the distribution. A summary of the principal items in the accounts is given below, for the past two years:—

	1907-8.	1906-7.
Ordinary share capital	£2,205,000	£2,075,000
Preference shares, 4½ per cent.	1,000,000	500,000
Obligation debt	2,446,000	19,685,000
Gross profits	670,716	652,139
Administrative expenses	65,808	60,112
Taxes	15,149	18,920
Tax of 10 per cent. paid to municipality	116,000	106,000
Profit share of municipal council	139,500	125,791
Depreciation provision	167,340	175,912
Net profits	869,451	849,162
Dividend on ordinary capital, per cent.	11	11

The number of consumers increased by 2,543 during the year, and the connections advanced by 17,538 KW. to 147,260 KW., whilst the sales rose from 142·92 million kilowatt-hours to 155·12 millions. Private consumers were responsible for 31·66 millions of the latter, public lighting for 3·90 millions, industrial establishments for 53·69 millions, storage battery installations for 5·47 millions and tramways for 55·90 millions, the balance of 4·50 million kilowatt-hours being used by the company's works. The average sale price, after deducting commercial taxes, amounted to approximately 2d. per kilowatt-hour, or a slight amount higher than in the previous year.

The report proceeds to state that the comprehensive new works and extensions are approaching completion. A site adjoining the Moabit generating station has been acquired for the enlargement of the latter, the space providing accommodation for plant of 30,000 KW., of which machinery representing 12,000 KW. is being installed this year. The central station at Rummelsburg has been opened with three turbo-dynamos of 12,000 KW. The total length of cables in Berlin and suburbs reaches 3,410 miles, of which 2,398 miles are for lighting purposes. It is expected that a period of quietness in the erection of new plant will now ensue, and the developments next year will principally lie in increasing the working funds of three central stations and the extension of the network of cables.

Eastern Telegraph Co., Ltd.

THE meeting of this company was held at Electra House on Wednesday last week, Sir John Wolfe Barry, K.C.B., presiding.

In moving the adoption of the report (see ELECTRICAL REVIEW, November 6th, page 817), the CHAIRMAN said the gross revenue for the half-year under review amounted in round numbers to £568,400, against, for the corresponding half-year of 1907, £593,400, or a reduction of £25,000; £12,000 of this decrease was due to a continued falling off in the receipts from traffic with South Africa, although there were indications of a revival in the traffic exchanged with that country. Receipts from messages exchanged with Australasia, China, Japan and Egypt also showed reductions as compared with the corresponding half-year; but, on the other hand, there had been a steady increase in the receipts from South American traffic, while small increases also occurred in other classes of traffic. Considering the long period of trade depression which this country had experienced, together with other countries in all parts of the world, he thought they should feel thankful that their revenues had not suffered to any greater extent than was shown in the accounts submitted. The business of submarine telegraphy was, of course, largely dependent upon international commercial activity, and no surer indication of the general state of the worlds' commerce could be found than in the rise and fall of the traffic receipts of this company, because they were not dependent, as was the case with some companies, on the volume of business exchanged between one or two countries, their revenues being derived from traffic emanating from the most important centres of the world. This circumstance was a source of strength to the company, and had enabled them to pay a steady and fair dividend to their stock-holders, while at the same time maintaining their reserves. They thus possessed a feeling of security, even during periods of depression such as those which had lately been universally experienced by nearly every commercial concern. Turning to the expenditure side of the accounts, it would be seen that the ordinary expenses for the half-year amounted, in round numbers, to £261,100, as compared with, for the corresponding periods of 1907, £243,500, or an increase of £17,600. This increase was practically accounted for under two headings—viz., working expenses at stations, and expenses attending maintenance of cables, including depreciation of stock cable, the former showing an increase over the corresponding half-year of about £4,800, and the latter £13,900. As regards the increased expenditure under Abstract "B," salaries and wages accounted for about £1,800, and was due to automatic increases in the salaries paid to staff. Their contribution towards the expenses of joint stations worked by other companies were £600 more, while the contribution from other companies towards the company's joint stations' expenses was £1,200 less than that for the corresponding half-year, this being due to an alteration of the proportions payable, covering a period of eighteen months, the whole of the adjustment being contained in the present accounts. So far as Abstract "C" was concerned, this was an item of expenditure which was necessarily of a varying nature, depending as it did upon the number of interruptions to the cables and to the extent of the consequent repairs. During the half-year under review, extensive repairs had been necessary to some of the cables, the quantity of new cable laid into the line being considerably in excess of that used in the half-year to June, 1907. The figure appearing in the accounts as representing the cost of maintaining the cables, would have been much larger were it not for the fact that their repairing ships had been engaged upon important work for other telegraph administrations, the credit under this heading being about £7,000 more than for the corresponding half-year. The cable ship *Amber* had undergone an extensive overhaul, and had been fitted with a new boiler, and in accordance with their usual custom an amount of £5,000 had been applied from the maintenance ships reserve fund towards this exceptional expenditure. The net result of the half-year's working, added to the substantial balance brought forward from last half-year, was that after providing for the usual interim dividends, they were able to carry £100,000 to the general reserve fund, and to carry forward a balance of £53,700. During the half-year it was decided to continue the renewal of the oldest of the Aden-Bombay cables. The cost of this work, £107,000, had been charged to the general reserve fund, for which purpose this fund was primarily maintained. In 1904 they began the renewal of this section, which was originally laid in the year 1870, and during the three half-years ended March, 1905, they charged £145,000 to the general reserve fund, the total charge to date in respect of this renewal being £252,000. The greater part of this cable had now been renewed, and the remainder would be taken in hand as necessity arose. Notwithstanding these heavy charges against the general reserve fund, that fund now amounted to about £1,138,000, while the total reserves aggregated to £1,785,000. The question of the reserve fund had frequently been referred to at these meetings. The subject was a very important one. No doubt the majority of the stockholders fully appreciated the benefits which they derived indirectly from the possession of a

substantial reserve fund, and he believed that the bulk of the telegraphing public also realised that this fund was administered and utilised for their ultimate benefit. The trade of the world was carried on to a great extent through the medium of submarine telegraphy, and as the rivalry of nations became more keen it played an increasingly important part in business transactions from day to day. It was essential, therefore, that the telegraph service should be maintained at a high standard of efficiency in order to keep pace with modern business methods. It was their constant endeavour to do this, and to grant additional facilities and reduce the rates to the public whenever it was practicable to do so. Reduced rates frequently necessitated an increase in their carrying capacity, which could only be provided by extra cables and improved apparatus. Their working expenses were, in consequence, considerably increased without, as was frequently the case, a corresponding additional revenue being secured. It followed, therefore, that these facilities could only be granted by the expenditure of large sums of money, which must be provided either by raising additional capital or out of the reserve fund. They considered it more prudent to adopt the latter alternative. They also considered it best to carry such sums to their reserve fund as would replace the large amounts which must be withdrawn from time to time and utilised to the mutual advantage of all concerned. Had this course not been pursued when, during the South African War, they expended nearly one and a half millions for the new cable to South Africa, they would have been obliged to issue additional capital, the revenue would not have grown correspondingly, and the company would not have been in the sound financial position in which it was that day. Neither would they have been able to carry out the many important reductions in the rates which they had made during the last few years to various parts of the world, to the great advantage of the public. Thus, the results of their policy had been that, from the point of view of the stockholders, they possessed a stable position with dividends that did not fluctuate with the ups and downs of trade, a position with which few joint stock enterprises could compare. From the point of view of the public, they had been enabled to provide the money for enormous extensions of the cables, with not only no increases of tariffs, but with most substantial reductions to all parts of the globe. He could give a few examples of the reductions they had brought into force during the last 14 years: Spain, a reduction of 25 per cent.; Portugal, 33; Gibraltar, 33; Malta, 25; Greece, 14; Egypt (Alexandria), 37; Aden and Perim, 47; Zanzibar and Mombasa, 68; Mozambique and Lourenco Marques, 71; Seychelles, 65; Mauritius, 71; South Africa, 71; India, 50; Penang, 30; Singapore, 39; China, 37; Japan, 54; Philippines, 51; South and West Australia, 37; Pernambuco, 43; Rio de Janeiro, 35; Buenos Ayres, 32; Chile, 35; Bolivia, 25; Peru, 29—or an average throughout the system of 48 per cent. Surely, therefore, any fair-minded man who had given a little time to study the methods adopted by the directors in order to fulfil their public duties, must come to the same conclusion as was arrived at by the Inter-Departmental Committee appointed by the Government to look into the whole question of the cable companies *vis-a-vis* the public and the Imperial and Colonial Governments. In conclusion, the chairman referred to the proposals for 1d. a word telegrams all over the world, and said the subject could never have been properly or even reasonably thought out by those who suggested it. He read an extract from the report of the Inter-Departmental Committee on Cable Communications of 1902, in which that Committee held that very large reductions in existing rates were quite impracticable.

Sir John Denison Pender seconded the motion, which was carried.

Replying to questions, the Chairman said he was still of opinion that wireless telegraphy was not going to be a material competitor with cable telegraphy. At the same time, they were putting up installations as feeders to their system, and if the time came when the system was still further developed, the company would be found to have kept abreast of scientific improvements.

Montreal Street Railway Co.

The report for the fiscal year ended September 30th, 1908, states that the gross earnings increased during the year by $173,789, or 4·96 per cent.; the operating expenses by $53,741, or 2·55 per cent.; and the net earnings by $120,048, or 8·58 per cent. The gross earnings show a satisfactory increase, considering the general depression in business; the percentage of expenses to gross earnings has decreased to 58·69, against 60·07 per cent. for the previous year. In the *Financial Times* we read that these satisfactory results are attributable to some extent to the fact that the principal main lines are now equipped with cars of the "pay-as-you-enter" type. The principal increase in fixed charges is due to the increased payment to the City of Montreal for the percentage of earnings, the amount due to the city being $242,431, an increase of $27,591 over the previous year. With regard to the contingent account, the directors appropriated during the year from the surplus earnings $175,000 for renewals. There has been charged against this amount during the year $157,285. The directors appropriated $25,000 from the surplus earnings as a credit to the fire insurance fund. The amount now at the credit of this fund is $423,959. The directors sold in England £460,000 of debenture bonds, and charged the discount to surplus account. They also issued to the shareholders in July last $1,000,000 new stock at 125, and credited the premium to the surplus account, leaving the amount at the credit of the general surplus $2,042,216, an increase of $69,513 over last year. The proceeds of the bonds and the calls paid in have been used to pay off the $292,000 bonds which matured on February 1st last, the £208,000 notes which matured June 29th, and the floating liabilities, as well as providing for the usual capital and construction requirements for the year. The financial statements of the Montreal Park and Island Railway continue to show satisfactory progress, the net surplus for the year turned over to the Montreal Street Railway on account of interest being $72,011, an increase of $16,909 over last year.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Metropolitan District Railway Co.—Scrip (fully paid) for £550,000 4 per cent. prior lien debenture stock.

And to allow the following securities to be quoted in the Official List:—

New York, New Haven and Hartford Railroad Co.—£5,784,750 4 per cent. 15-year European Loan of 1907 in bonds of £19 15s. 6d. (500 f.) each, Nos. 1 to 290,000.

The Committee have appointed a special settling day as under:—

Wednesday, December 2nd.—British Aluminium Co., Ltd.—£700,000 5 per cent. mortgage debenture stock, fully and partly (£50 per cent.) paid.

And ordered same to be quoted in the Official List, as well as—

New York, New Haven, and Hartford Railroad Co.—£5,784,750 4 per cent. 15-year European loan of 1907 in bonds of £19 15s. 6d. each (500 fr.), Nos. 1 to 290,000.

Bullers, Ltd.—The directors' report for the year ended July 31st last, as quoted in a financial contemporary, states that the year has been one of continued depression in trade, and competition has been keener and more severely felt than in any year of the company's history. Profits in consequence have been very largely reduced, though the volume of business has been fairly maintained. In order to meet the altered conditions of trade in the colonies and elsewhere, the directors are establishing agencies in Africa, Australia, New Zealand, India, &c. The benefits of these representations must necessarily take time to develop, but it is expected that by these means the company will gain closer touch with the large buying centres in the colonies and other places. The accounts, after paying directors' fees and managing directors' salaries, show a profit of £14,659, which, with £1,247 brought forward, makes a total of £15,906. The directors regret that this is not sufficient to declare any further dividend on the ordinary shares. The interest on the preference shares, £7,500, and dividends of 5 per cent. on the ordinary shares, £7,500, have been paid, leaving £906, which the directors propose to carry forward.

Prospectuses.—*The Anchor Cable Co., Ltd.*—This company is offering for subscription an issue of £50,000—4½ per cent. debenture stock at par. It is part of a total issue of £60,000, and the issue is guaranteed both as to principal, interest, and premium, by Callender's Cable and Construction Co., Ltd., who have carried on and financed the business since 1903 as a separate concern. The assets in the last balance-sheet were £125,196. The manufacturing profit for the last two years was £7,005 and £7,983 respectively, these sums being arrived at after charging all establishment and management expenses and directors' fees, but not the interest on the Bank loan, which will be repaid out of the proceeds of the present issue. The list closes to-morrow (Saturday).

University College Hall, Ltd.—This is an issue of 6,290 £1 shares, the dividend of which is limited to 5 per cent. per annum. The company has been formed by individual members of the Governing Committee and Professional Board of University College, and others, to supply within easy reach of the College, a home for students whilst pursuing their studies at the College. Last March a prospectus was issued in a limited circle, and 3,710 shares were allotted as a result. £166 has also been received in donations. The purchase of the property was completed, and the Hall of Residence was opened on October 5th, with every available room let. By January next the new wing will be ready for occupation.

Les Tramways de Szegedin.—Subscriptions are invited for 10,000 shares and 3,000 bonds in this Belgian company.

Dorman, Long & Co., Ltd.—A final dividend of 4 per cent., making 6½ per cent. for the year has been declared.

Richard Hornsby & Sons, Ltd.—Dividends on ordinary and new shares for the year ended September 30th at the rate of 6¼ per cent. per annum are recommended. £15,000 is placed to reserve, £2,500 is written off patents, and £4,243 is carried forward.

Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd.—A dividend for the half-year ended September 30th on the ordinary shares at the rate of 7½ per cent. per annum is declared.

Anglo-Portuguese Telephone Co., Ltd.—The directors announce a dividend of 3 per cent., free of income-tax, for the half-year.

Richardsons, Westgarth & Co., Ltd.—According to the *Financial Times* no dividend can be paid to shareholders owing to the prolonged strike in the engineering trade.

France.—La Société Industrielle des Telephones, of Paris, is declaring a dividend of 16½ fr. per share for the last financial year; the balance-sheet shows a net profit of £73,634, as compared with £71,128 in the preceding 12 months.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Nov. 11	3,553	+ 152	24	35,515	— 170	14·4	..
Ayr	,, 14	264	..	26	9,378	— 252	8	..
Bath	,, 11	1,375	+ 17	45	33,773	— 2,296	13	..
Belfast	,, 13	7,226	— 45	33	120,053	— 1,400	37	..
Birkenhead	,, 15	1,993	— 44	33	35,584	+ 380	13·52	..
Birmingham Corp.	,, 7	13,910	+ 180	31	202,685	+ 6,426	56·46	..
Blackpool Corp.	,, 17	3,906	— 839	..	37,578	— 983	11·87	..
,, —Fleetw'd.	,, 14	556	+ 58	19	20,034	— 1,814	8·25	..
Bolton	,, 15	4,254	— 124	33	77,468	+ 1,108	26	..
Bournemouth	,, 11	2,789	— 18	32	56,542	— 2,992	21·72	..
†Bradford	,, 7	4,328	— 82	31	151,784	+ 408	54·9	..
Brighton	,, 15	1,489	— 3	32	32,342	+ 685	9·5	..
Bristol	,, 14	9,591	— 7	..	..	..	31	..
Brit. Elec. Trac. Co.								
Airdrie	,, 6	442	— 30	44	9,884	— 39	3·65	..
Barnsley	,, 6	346	+ 11	,,	7,874	+ 431	..	..
Barrow	,, 6	423	— 29	,,	10,982	— 542	5·37	..
Cavehill	,, 6	134	— 3	,,	3,994	+ 157	..	..
Devonport	,, 6	916	+ 53	,,	20,700	+ 239	8·85	..
Gateshead	,, 6	2,028	— 88	,,	44,819	+ 117	11·25	..
Gravesend	,, 6	372	— 80	,,	9,467	— 1,530	6·5	..
Greenock	,, 6	960	— 236	,,	23,506	— 5,859	7·25	..
Hartlepool	,, 6	440	— 87	,,	10,719	— 2,372	6·72	..
Kidderminster	,, 6	180	— 16	,,	5,026	— 372	..	..
Leamington	,, 6	325	+ 45	,,	7,731	+ 470	3	..
Merthyr	,, 6	417	— 21	,,	9,400	+ 20	2·9	..
Metropolitan	,, 6	11,413	+2,110	,,	256,853	+48,499	22	..
Middleton	,, 6	582	— 74	,,	15,953	+ 111	8·5	..
Mid. Joint Com'tee	,, 6	11,288	— 763	,,	255,218	— 5,818	..	..
Oldham—Ashton	,, 6	1,066	— 180	,,	26,264	— 707	9·13	..
Peterborough	,, 6	220	— 10	,,	5,778	+ 1	5·31	..
Potteries	,, 6	3,718	— 263	,,	80,089	— 2,174	29	..
Rothesay	,, 6	90	..	,,	9,596	— 504	2·75	..
Southport	,, 6	466	+ 21	,,	12,759	— 768	8·17	..
S. Metropolitan	,, 6	1,525	+ 15	,,	36,400	+ 459	..	..
Swansea	,, 6	1,825	+ 62	,,	42,061	+ 931	12·5	..
Tynemouth	,, 6	296	— 11	,,	10,334	— 748	3·75	..
Weston-s-Mare	,, 4	75	— 8	,,	6,604	— 106	3	..
‡Worcester	,, 6	511	— 9	,,	12,679	— 83	5·75	..
Wrexham	,, 6	197	+ 4	,,	4,584	— 9	..	..
Yorks. Wool. Dist.	,, 6	1,785	— 18	,,	40,817	— 795	17	..
Miscellaneous	,, 6	359	— 61	,,	9,274	— 744	..	..
Burnley	,, 14	2,167	— 272	..	..	..	7·5	..
Burton-on-Trent	,, 15	490	+ 12	33	9,104	— 600	10	..
†Bury	,, 8	2,097	— 75	31½	88,237	+ 1,847	22·5	..
Cardiff	,, 7	3,964	— 50	32	70,359	— 157	..	..
Carlisle	,, 14	319	— 31	45	8,086	— 4	..	..
Chatham and Dist.	,, 12	1,551	+ 222	47	37,756	+ 4,454	14·98	2·82
Cork	,, 12	881	+ 61	45	20,951	— 522	9·89	..
Croydon	,, 13	2,575	— 82	33	47,467	— 501	11·25	·75
†Darlington	,, 7	187	— 22	32	6,387	— 493	..	..
Darwen	,, 13	445	— 44	32	..	..	4·36	..
Dover	,, 7	368	— 17	32	7,560	— 310	4·75	..
Dublin	,, 13	9,919	— 966	..	108,514	—28,694	54·25	5·5
Dundee	,, 11	2,304	+ 78	25⅝	51,554	+ 1,642	14·5	..
East Ham	,, 14	1,754	+ 71	33	29,166	— 1,154	8·43	·68
Exeter	,, 6	582	+ 77	33	10,814	+ 14	5·5	..
Glasgow	,, 14	33,721	—1,079	..	414,274	— 7,983	90·5	1·5
Hastings	,, 12	1,732	— 7	..	..	..	..	..
Huddersfield	,, 14	2,811	— 221	33	53,388	— 871	28·5	·5
Hull	,, 14	4,845	— 135	33	81,297	+ 8	13	..
Ilkeston	,, 12	294	— 20	32	4,687	— 31	3·5	..
Ipswich	,, 14	650	+ 1	33	13,662	— 273	10·5	..
†Kilmarnock	,, 7	142	— 2	25	3,893	— 242	4·28	..
Lan'kshire Trm. Co.	,, 12	2 504	— 82	45	58,535	+ 3,171	17	1·18
Lancashire United	,, 11	2,907	— 149	45	60,520	+ 2,218	39	1
†Leeds	,, 7	6,268	— 92	29	213,870	+ 3,737	96·75	·25
Leicester	,, 15	4,329	— 126	..	..	— 57	..	..
Leith	,, 7	996	— 21	25⅝	18,819	— 57	6	..
Liverpool	,, 7	21,410	— 517	45	481,361	—10,152	104	..
‡L.C.C.	Oct. 31	71,401	+7,187	..	1,089,330	+123,648	121¾	..
London United	Nov. 14	10,725	— 168	..	305,815	+ 4,196	..	..
Lowestoft	,, 14	323	— 25	7	1,175	— 70	3·5	..
Manchester	,, 14	28,817	— 54	33	503 572	+12,744	89·5	11
Newcastle	,, 14	7,594	— 544	33	128,677	— 7,646	..	..
Newport	,, 14	1,204	— 42	33	22,118	— 1,126	14·5	..
†Northampton	,, 10	483	+ 752	27½	13,377	..	5·5	..
Oldham	,, 15	3.461	— 343	33	66,216	— 574	23·75	..
Pontypridd	,, 7	797	+ 255	32	12,286	+ 3,665	5·5	1·75
Portsmouth	,, 14	3,336	+ 29	33	69,589	+ 414	14·5	..
Preston	,, 11	1,351	— 73	..	..	..	..	..
†Reading	,, 12	1,127	— 46	32	20,672	+ 74	13·25	..
Rotherham	,, 12	1,905	— 28	32½	20.128	+ 56	10	·66
Salford	,, 9	8,895	— 241	32	142,691	— 125	38·9	..
Sheffield	,, 15	10,653	— 572	33½	187 955	— 2,254	87	1·25
Southampton	,, 11	1,961	+ 31	32	35.8.9	+ 1,549	..	..
Southend-on-Sea	,, 11	693	+ 121	33	16,067	+ 1,375	..	..
South Shields	,, 7	1,046	— 14	..	18,861	— 317	..	..
†Swindon	,, 4	189	— 16	..	..	..	4·4	..
Tyneside	,, 11	764	— 56	19	8,211	— 874	8·97	..
Wallasey	,, 7	1,593	+ 92	32½	30,908	+ 1,521	8·72	·22
Walthamstow	,, 14	1,090	+ 92	33	21,958	+ 1,106	9	..
West Ham	,, 5	4,378	— 155	32	71,562	— 3,761	14·7	..
Wolverhampton	,, 11	1,560	— 79	32	27,584	— 652	12·5	..
Baker St.-Waterloo	,, 14	6,200	+ 525	20	57,325	+11,810	4·25	1
Cen. London Rly.	,, 14	11,788	— 415	20	112,719	+46,411	6·32	·55
Char. +, Eus. Hamp.	,, 14	7,135	+1,180	20	66.845	+14,850	7·75	..
City & S. Lon. Rly.	,, 15	6,218	— 267	20	60,380	+ 1,346	7·2	1·05
†Dublin-Lucan Rly.	,, 6	121	+ 22	18	2,745	— 2	7	..
G.N. and City Rly.	,, 14	2.899	— 946	20	26,630	— 6,450	3·5	..
G.N., P'dy. & Brmin.	,, 14	10,710	— 880	20	101.555	+18.575	9·25	·25
L'pool Overh'd Rly.	,, 15	2,710	— 101	20	28,199	— 9,539	6·2	4·3
Mersey Railway	,, 14	7 868	+ 151	20	87,426	+ 826	4·5	..
Metropolitan Rly.	Oct. 18	34.428	+2,781	16	259,904	+18,756	16	..
Met. District Rly.	Nov. 14	19,°00	+1.815	20	184,818	+30,008	24	..
Anglo-Argentine	,, 11	54,795	+17,588	..	960.009	+198,646	43	..
§Auckland	Oct. 9	12.864	+2,160	40?	123,413	+19 595	22·3	3·1
Bombay (B.E.T.)	,, 22	5,088	+ 621	40	100,238	+17,088	..	..
§Brisbane	,, 8	14,910	+1,878	..	..	..	..	..
Calcutta	Nov. 14	6.700	+ 312	..	..	..	..	..
§Geneva	Sept.	9,755	+ 634	..	..	..	..	..
§Kalgoorlie, W.A.	Oct.	3,600	..	44	29,186	..	20·5	..
Madras	Nov. 15	1 149	— 18	46	25 927	+ 1,800	12·75	..
†Perth (W.A.)	,, 18	2.618	— 260	46	62,685	+ 1,474	25·6	..

* Compared with the corresponding period of 1907. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

NEAR-EASTERN politics again play a prominent and a disturbing part in the Stock Exchange area. The restlessness of Servia is much disliked, and produced a general dulness over investment departments, in which Home Railways suffered with the rest. Reassuring cables went some way towards restoring confidence, but an unpleasant feeling of anxiety remains behind. Moreover, there are several new issues impending in the gilt-edged market, and with a possible tightening of money as the end of the year comes in sight, there is not very much to "go for" from the point of view of prospective purchasers.

Copper, the metal, is highly animated, fluctuating rapidly in both directions. Those who favour a further rise point to the Pennsylvania Company's proposed extension of its electric service as one indication of what may be expected in the case of other important U.S. railroads. The Pennsylvania is said to contemplate an electric service of trains running 120 miles an hour to Philadelphia; "Very electric!" was one caustic comment overheard in the Stock Exchange. On the other hand, there are copper experts who still maintain that the statistics show ample supply to be available for meeting any ordinary demand which is likely to arise.

Metropolitan Railway Consolidated stock continues to recede, and the price at 37 shows ½ per cent. loss. Districts remain at 13, with desultory offering and bidding for the stock roundabout that figure. Central London Ordinary moved down a point; City and South Londons remained at 33.

Tramway stocks and shares are steady to good. Anglo-Argentine Second Preference gained as much as 5s. City of Buenos Ayres (1904) are steady at 5⅝, *ex* 1/10 dividend. Buenos Ayres Grand National Ordinary hardened slightly, to 2⅜. British Columbia Electric Railway stocks are firm, the Deferred recovering 2 points of the 4 per cent. dividend deducted last week. Dublin United Tramways Preference rose to 13½, an advance of 15s., of which part had certainly taken place before, without the Stock Exchange Official List recording it.

From the hints given during the last two or three weeks as to the progress of negotiations between the Mexican Light and Power and the Mexico Tramways Companies, readers perhaps will not be surprised to hear of another rise of 7½ points—making 11½ within the fortnight—in the price of Mexico Tramways Common stock. The quotation has now reached 147, and the 5 per cent. bonds are 92½. Mexican Light and Power Common stock put on 2 points, the Preference rose ½, and the 5 per cent. bonds of the Mexican Electric Light Company regained their previous fall of 2.

By putting on another 4 points, Rio de Janeiro Trams nearly equalled the rise which has occurred in Mexico Tramways within a couple of weeks, the price being up to 79½, while the bonds at 92½ are 1 better. All the issues of this group are strong. Canadian General Electric Common shares rose to 107½, and the 7 per cent. Cumulative Preference stock kept firm at 114.

Calcutta Trams remain flat because of the sedition in the city, and the market has become so narrow as to partly justify the heavy margin between buying and selling prices as furnished by the official quotation. The Stock Exchange Committee, however, are taking further steps to get more reliable prices recorded in the list, more particularly in the way of having the margins decreased between the two sets of figures given. It is marvellous that a body of men like those in the Stock Exchange cannot discern how the present system plays directly into the hands of bucket-shops, and affords a ready means whereby the public may be fleeced by outsiders under the shelter of Stock Exchange official practice. Our price-lists, especially those for electricity supply varieties, show how the Committee's requisitions have already been complied with.

Apart from this, Electricity Supply descriptions jog along in their usual humdrum style. Edmundson's 4½ per cent. First Debenture stock is better, but the metropolitan list shows little actual change. Victoria Falls Power Preference drooped to 10s., after their recent giddy rise of about eighteenpence.

The telegraph section displays more movement. It is singular to notice that while Anglo-American Telegraph Deferred lost some of its sharp rise, the Ordinary and Preferred stocks both improved. Eastern Extensions are weak, falling 7s. 6d. to 12½, and Eastern Telegraph Ordinary is down a point to 136½. Agitation for penny-a-word cablegrams is rather disturbing proprietors of these securities. The discrepancy between the two quotations is very marked. A few movements of ½ and 1 in debenture stocks have taken place. Marconi shares have risen 1s. 3d., so that the middle price is 11s. 3d., as against 7s. 6d. on November 3rd.

American Telephone and Telegraph capital stock has a further 2 points to its credit, and a dramatic rise of 7½ in Mackay Companies' Common is ascribed to buying based on the Taft victory. National Telephone stocks are steady.

In the miscellaneous division, Babcock & Wilcox rose ½ to 4, while General Electrics, at 7, are ¼ down. Edison & Swan shares of both kinds are *ex* their dividends, and no alteration is made in their quotations. Willans & Robinson Debenture shed a couple of points. Armament shares are buoyant, Armstrongs and Vickers being decidedly better on the week, and there is a lot of business doing in rubber issues; the lower priced shares in the producing companies are in considerable favour on behalf of the speculative investor attracted by the rise in the price of the raw material.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Nov. 10th.	Closing Quotations Nov. 17th.	Business done week ended Nov. 17th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅛ — 2½	2⅛ — 2½	..	..	..	Nil.
136,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¼%	7¼%	8 %	8 %	131 —135	134 —137	131½	..	+2½	5 16 10
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94 — 96	94 — 96	..	..	..	4 3 4
598,180	Anglo-American Telegraph	Stock	2⅝%	3½%	3½%	3½%	57 — 60	58 — 61	59½	57½	+1	5 14 9
3,200,910	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	102 —103	102 —103	104	102½	..	5 16 6
3,200,910	Do. do. do. Deferred	Stock	Nil	⅛	1⅜	1 %	17½ — 17¾	17½ — 17¾	17¾	17½	— ⅛	5 16 9
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	99 —102	100 —109	..	..	+ ⅛	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8½	8 — 8½	8½	..	..	4 14 1
2,388,376	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	88½ — 90½	89 — 91	90	89	+ ½	4 7 11
16,000	Cuba Telegraph	10	5 %	5 %	5 %	6 %	7½ — 8½	7½ — 8½	..	..	..	7 1 2
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16½ — 17½	16½ — 17½	..	..	..	5 15 11
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	8 14 10
60,710	Direct United States Cable	20	3½%	4½%	4½%	4½%	18½ — 19⅝	18½ —19⅝	18½	18	..	6 2 6
50,900	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,900, R.	100	4½%	4½%	4½%	4½%	100 —102	101 —103	..	..	+1	4 7 5
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	134 —137	136	124	+1	5 2 2
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	84 — 86	84 — 86	85½	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103½ —105½	103½ —105½	104½	..	..	3 17 8
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12½ — 12¾	11⅞ — 12⅛	13⅛	11⅞	— ⅛	5 13 2
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
269,700	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99½—101½	100 —102	..	..	+ ½	3 18 8
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
181,127	Globe Telegraph and Trust	10	5⅝%	5⅝%	5⅝%	5⅝%	10½ — 11	10½ — 11	10½	10½	..	5 9 6
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜ — 13¾	13⅜ — 13¾	13½	13⅜	..	4 6 6
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	30 %	30 %	30 — 32	30 — 32	30½	30¼	..	6 5 0
19,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	101 —103	..	..	+1	4 7 5
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	56 — 59	56 — 59	66	57	..	5 2 7
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	4 %	70 — 73	73 — 82	78½	..	+7½	4 17 7
$50,000,000	Do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	68 — 72	70 — 74	..	..	+2	5 8 1
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅞ — 1	⅞ — 1	12/9	..	+ 1/8	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	⅞ — 1	1 1/16 xd	..	..	..	5 12 11
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ xd	..	..	..	5 3 11
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110	109	..	5 8 1
3,725,000	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	117 —119	117 —119	118	117½	..	5 0 10
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 11¼	10¾ — 11¼	..	..	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10¾ — 11¼	10¾ — 11¼	..	..	..	4 8 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 7/16 — 5 9/16	5 7/16 — 5 9/16	5⅝	..	..	4 7 1
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	99	..	3 10 4
1,716,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	101 —103	102½	101¼	—1	3 17 8
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	7 %	7 %	8 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 16 4
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 16 0
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	..	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100½—103½	101 —103	..	..	..	3 17 4
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	4½%	100 —102	100½—102½	..	..	..	4 7 10
3,083	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
100,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝ — 6¾	6⅝ — 7⅛	6 15/16	6 13/16	..	5 16 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 11
30,008	W. Coast of America, 1 to 30,000 & 58,001 to 58,008	2½	Nil	Nil	2½%	2½%	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —103	101 —103	..	..	+ ½	3 17 8
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13½ — 14	13 — 13½	13⅜	..	— ⅛	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..	3 16 11
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	6 %	8 — 8½	8 — 8½	8⅝	8½	..	7 1 2
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	£2 6	8½ — 9½	8½ — 9½	..	..	..	2 9 0
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101½—103½	..	..	+ ⅛	4 16 7

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,007	5	8 %	8 %	8 %	9 %	8⅜ — 8⅝	8⅞ — 9⅛	9 3/32	8⅝	+ ⅛	6 6 4
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	5⅛%	6 5/16 — 6 5/16	6 5/16 — 6 5/16	..	..	..	4 10 3
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	141 —146	141 —146	..	..	..	4 2 2
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
330,000	Babcock & Wilcox, 1 to 330,000	1	20 %	20 %	20 %	20 %	3¾ — 4	3¾ — 4	70/4½	77/6	+ 1/16	5 1 6
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	3 13 10
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	1¾ — 2¼	1⅞ — 2	40/-	35/-	— ⅛	17 10 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	3 — 4	2¾ — 3½ xd	70/-	65/-	— ⅛	10 0 0
40,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4 — 4½	3¾ — 4½	..	..	— ⅛	7 1 2
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	3¾ — 4½	3¾ — 4½ xd	..	..	— ⅛	4 8 11
43,473	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	104 —108	105 —108	..	..	+ ½	4 12 7
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	5½%	5½%	97 —100	98½—100½	..	..	+1	5 9 5
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	8 %	136 —140	134 —138	140	136	—2	5 15 11
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	115 —119	116 —120	116½	116¼	+1	4 3 4
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	106 —110	107 —109	108	..	+1	4 11 2
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	101 —103	101 —103	102	101⅛	..	10 17 6
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
138,301	British Electric Traction	10	6 %	3 %	Nil	Nil	⅞ — 1⅛	⅞ — 1⅛	..	..	+ 1/16	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	8 %	3½ — 4	3½ — 4	74/4½	72/6	..	7 10 0
1,478,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 6 3
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	76 — 78	73 — 75	78⅜	..	..	6 0 0
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	10 %	6½ — 6⅝	6½ — 6⅝	..	..	— 1/16	7 10 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛	6 1/16	..	— 1/16	4 14 1
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
208,440	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	91 — 96	91 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	10/-	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	40 — 45	40 — 45	..	..	..	8 17 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	⅞ — 1⅛	⅞ — 1⅛	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	2½%	Nil	Nil	..	..	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	Nil	..	..	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	6 3 3
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	50 — 54	50 — 54	..	..	..	8 6 0
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	4⅛ — 5	4⅛ — 5	95/3	92/6	..	6 0 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	5 %	5 %	5 %	4⅛ — 5⅛	4⅛ — 5⅛	5 1/16	5	..	4 17 7
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	15 %	9½ — 10½	9½ — 10½	..	..	..	7 2 10
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½ — 5¾	5½ — 5¾	..	..	..	5 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107½—109½	107½—109½	..	..	..	4 2 2
491,222	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	12 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	33/-	31/10½	..	7 14 10
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	103 —107	103 —107	105½	105	..	4 6 11
1,893,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	68 — 70	67 — 69	68½	67	—1	4 5 9
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86	..	..	4 10 11
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	£0 — £0	51 — 53	..	..	+ ½	8 15 6
1,480,000	City and South London Railway	Stock	2¾%	1⅞%	2¾%	2¾%	32½ — 33½	32½ — 33½	33½	32½	..	6 6 10

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 10th.	Closing Quotations Nov. 17th.	Business done week ended Nov. 17th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	5 %	5 %	1⅝— 1⅞	1⅝— 1⅞	..	..	—1/16	10 0 0
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	98 —101	98 —101	..	..	..	4 19 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	7 12 5
305 000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	4 16 0
276,880	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6½%	11⅜— 12⅜	11¼— 12⅜	..	..	..	5 4 0
60,000	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	13 — 14	..	..	+ ⅜	4 5 9
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	2½%	4½%	4½%	4½%	1/16— 3/16	3/16 xd	..	..	..	16 12 6
17,189	Do. "A" shares, 01—017,189	5	2½%	4½%	4½%	4½%	1⅛— 2⅛	1⅛— 2⅛ xd	..	..	..	8 6 9
317,875	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	76 — 79	76 — 79	..	..	..	5 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 — 87	85 — 88	..	..	+1	5 13 8
112,100	Electric Construction, 1 to 112,100	2	4 %	Nil	Nil	Nil	7/16— 7/16	3/8 —	..	..	—1/16	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1½ — 1⅝	1½ — 1⅝	..	..	..	8 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7 — 7⅛	6⅞ — 7⅛	..	..	— ⅛	6 17 11
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	84 — 88	84 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	4 %	⅞ — 1	⅞ — 1	..	..	..	5 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅛ — 10⅜	10⅛ — 10⅜	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	103 —106	103 —106½	..	..	+ ⅛	4 16 10
40,000	Hanley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15%	10⅜ — 11⅜	10⅛ — 11⅛	..	..	..	7 8 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10
150,000	Do. do. 4 % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 — 109	107 —109	..	..	..	4 2 7
60,000	India-Rubber, Gutta-percha & Telegraph Works	10	5 %	10%	10 %	10 %	16½ — 17⅜	16⅝ — 17⅜	..	..	..	8 1 7
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	¼%	1 — 1⅛	1 — 1⅛	..	..	— ⅛	4 7 6
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5⅛	4⅞ — 5	..	..	— ⅛	10 0 0
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	3 %	3 %	3 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	4 8 11
299,930	Do. do. 50,008 to 100,000	10	6 %	3 %	3 %	3 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	9 1 10
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	70 — 75	70 — 75	..	..	..	5 6 8
5,782,062	Metropolitan Consolidated	100	3 %	2½%	1 %	¼%	37 — 38	36½— 37½	38	36⅞	— ⅛	1 6 9
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	67 — 69	67 — 69	67⅝	67⅜	..	3 19 9
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	12½ — 13½	12⅝ — 13½	13⅜	12⅝	..	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¼ — ⅜	¼ — ⅜	..	..	..	5 19 5
823,800	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	94	..	..	4 14 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	4 %	⅜ — ½	⅜ — ½	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜ — ½	⅜ — ½	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	92 — 95	90 — 93 xd	..	..	..	4 14 9
37,250	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	82 — 84	82 — 84	83½	..	..	6 18 8
150,000†	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101½—103½	..	..	+ ⅛	3 17 8
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	..	91½— 92½	92½— 93½	93⅝	92½	+1	..
2,800,000	Do. do. 4½% Bonds	..	..	..	..	..	75⅜— 76⅜	75⅜— 76⅜	..	..	..	..
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	23 — 24	23 — 24	..	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	⅛ — ¼	⅛ — ¼	..	..	..	10 0 0
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	2⅜ — 2⅞	2⅜ — 2⅞	..	..	— ⅛	10 8 8
246,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 76	70 — 74	..	..	— 2	5 8 1

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5⅜%	5½%	4⅜— 4⅞	4⅜— 4⅞	..	..	..	5 11 5
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	94 — 98 xd	94 — 98	..	..	..	4 10 0
30,275	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	6⅞ — 7⅜	7 — 7⅜	7⅛	..	..	6 13 4
9,725	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅜	7 — 7⅜	..	..	..	4 13 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 — 102	99 —102	..	..	..	3 18 5
60,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3½ — 4	3⅝ — 4	76/9	75/7½	..	6 5 0
60,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	79/9	78/9	..	5 5 11
60,000	Do. "City Undertaking" 4½ % Cum. Pri.	5	4½%	4½%	4½%	4½%	3⅝ — 3⅞	3¾ — 3⅞	75/-	..	+ 1/8	5 16 2
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	97 — 99	98	..	+ ½	4 10 11
49,486	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	4½%	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	6 13 4
175,000†	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	101	100½	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9 — 9⅜	9⅛ — 9⅜	9⅜	..	..	6 8 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12½— 13	..	..	+ ⅛	4 12 4
400,000†	Do. 5 % Db. Stk., Scrip. (iss. at 11⅝) all pd.	..	5 %	5 %	5 %	5 %	122 —125	123 —125	123½	..	+ ⅛	4 0 0
300,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —103	..	..	— ½	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	2 %	2⅜ — 3	2⅜ — 3	..	..	..	3 6 8
60,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3⅞ — 4	3⅞ — 4	..	..	..	6 5 0
200,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	..	99 —101	99 —101	..	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7 — 8	7⅜ — 7⅞	..	..	— ⅛	6 9 0
50,026	Do. do. 6 % Pref., 40,001—90,026	10	6 %	6 %	6 %	6 %	10⅜ — 10⅞	10⅜ — 10⅞	..	..	..	5 11 8
400,000†	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	107⅞	107½	..	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	Nil	¾ — 1	¾ — 1	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	59 — 66	62 — 65	..	..	..	6 18 6
$3,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	..	82 — 85	84 — 86	85½	84½	+1½	..
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 4 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 11
15,000	Hove, 1 to 15,000	5	8½%	9 %	9 %	6½%	6 — 6⅛	6⅛ — 6⅜	6⅜	..	+ 1/16	6 10 9
$1,325,000	Kaministaquis Power Co., 5 % Gold Bnds.	..	..	..	..	..	94 — 96	93 — 97	95⅜	95⅜	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	10 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	— ⅛	5 14 3
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	2	3 %	4 %	4 %	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	— 1/16	5 17 6
70,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	— 1/16	6 13 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 92	89 — 92	90⅜	89½	..	4 17 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	4⅜ — 4⅝	4⅜ — 4⅝	90/-	..	..	6 16 10
76,151	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	87/6	..	..	4 12 4
220,000†	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —109	106 —109	..	..	+ ⅛	4 2 7
248,000†	Do. 4½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	84 — 89	85 — 89	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	84 — 86	86 — 87	87	86	+1½	5 14 11
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	..	74 — 76	76½— 77½	78⅜	75	+1½	..
$1,500,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	..	103½—105½	104 — 106	105⅞	105	+ ½	..
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	..	88 — 90	88 — 90	£92⅜	88½	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	96⅛	95⅝	..	4 11 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	4⅛ — 5⅛	4⅛ — 5⅛	..	..	— 1/16	7 12 5
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	+ 1/16	4 10 11
10,853	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11⅜— 12⅜	11⅜— 12⅜	..	..	..	6 17 8
20,000	Oxford, 1 to 95 and 407 to 20,210	5	7 %	7 %	7 %	7 %	6⅛ — 6⅜	6⅛ — 6⅜	6⅜	..	..	5 12 0
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 99	95 — 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	..	2½%	..	1⅛— 1⅛	1⅛— 1⅛	25/-	24/8	..	..
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6	6	6	6	1⅛— 1⅛	1⅛— 1⅛	..	..	..	..
194,684	Do. do. 5% Deb. Stk. Red.	100	5	5	5	..	99 —102	99 —102	101	..	..	4 18 0
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	13½%	10 %	10 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	6 5 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	4 13 4
150,000†	Do. do. 5½ % Deb. Stock Red.	100	5½%	5 %	5½%	5½%	86 — 90	86 — 90	..	..	..	5 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛ — ¼	1/16— 1/8	..	..	..	Nil
45,700	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	68 — 72	68 — 72	..	..	..	5 11 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	7 12 5
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅛ — ¼	⅛ — ¼	..	..	..	4 0 0
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1½	1 — 1½	21/10½	..	+ 1/16	6 4 5
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	+ 1/16	20 0 0
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛— 2⅛	1⅛— 2⅛	..	..	— 1/16	10 15 4
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	82	81	..	5 8 5
800,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	..	⅝ — ¾	15/16— 1	..	..	— 1/16	..
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	10 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..	5 17 8
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	— 1/16	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 2½ per cent. May 28th, 1908.

ELECTRICAL DRIVING IN COTTON MILLS.

By W. H. BOOTH.

(*Concluded from page* 866.)

Turning now to the third estimate for imported current, the capital cost is seen to be halved so far as the millowner is concerned. It is, however, certain that the central power station has plant which fully makes up the difference, not to mention the expensive pole transmission line. Moreover, no general power station can pretend to possess more than half the load factor of any one of the cotton mills it may number among its customers. The power station cannot purchase coal or stores on better terms than its customers. Now, some one must pay interest on the line cost, for the line loss of current, and for the station plant, and poor load factor. There appears but little prospect that such a general station can sell current at a price that will pay both the station and the spinning mill. According to the figures put forward by Mr. Snell a year ago, Manchester cannot sell current at a profit for anything like 0·657d. per unit.

Consideration of the above facts, however, does seem to point a way to a system of electrical driving that would show an economy. If Lancashire be examined, it will be found that there are numerous groups of mills all very close together. Assume it to be possible to start to-day to build these groups afresh, it would be perfectly practicable to drive them from a central power station, to heat them and to light them from the same station, and the load-factor of the station would be better than that of the mills, so that there would be less surplus of machinery, and the ordinary low load-factor losses of the common power station would not occur. There would be no transformer costs, no rope races, very little line loss, and no heating boilers, &c., at the mills.

The great cost of the 200 to 300 per cent. extra expensive running machinery is, of course, the chief item in electrical driving. In a widely spread dockyard, an ironworks, or a shipyard, and even in machine shops, this expenditure replaces costly lines of condensing steam pipes, various scattered groups of boilers each with its expensive attendants, isolated wasteful engines, uncared-for line shafts and other items which consume power and fuel wastefully. But it is a very different affair to provide this costly plant to drive a matter of 1,500 or 2,000 H.P. packed into a single four-floor block of buildings, full of machines all at work, and all within a short rope drive of the source of power. The writer is convinced that the cotton-mill proposition cannot be so airily dealt with as some would try to make believe.

No one is likely to deny that in many, if not in all, bleach works or calico printing works, a very considerable economy must be secured. But the conditions are wholly different from those of a spinning mill. And some people have already found this out—by paying for it. Others have been carried away by electrical driving as seen in American mills, with water-power transmitted from a distance. But such cases differ entirely from coal-generated electricity, transmitted from near to one coal pit to points equally near to other coal pits.

In the estimates of running costs, coal is seen to amount to about two-fifths of the total costs in (*a*) and (*b*).

In the case of (*c*) current amounts to 77 per cent. of the total costs, and actually to more than the total costs of case (*a*). If current could be sold for $\frac{3}{8}$d. per unit, purchased current would beat rope driving for total economy.

The problem before the electrical engineer is thus brought down to selling current for $\frac{3}{8}$d. transformed at the mill door. And having done this, it must be there as reliable as is rope-driven power.

There does not, so far, seem much prospect of economy for a full electrical installation at the factory. But if engineers would seriously take in hand the utilisation of power now going to waste in the shape of blast furnace gas, it would be found possible to transmit electricity and sell it for even a less figure. This, of course, presupposes transmission at high voltages, such as is done in Canada and America, where for years transmissions have been at work on lines which English electricians have pronounced impossible. In Mexico also these high voltages are common. In a country so fully settled as England, it should certainly be far easier and safer to install and guard a high-tension pole line than it can be in Mexico or Canada. But to expect coal-driven steam stations to compete at a distance with the simple mechanical plant of a cotton factory, itself next door to a coal pit, is entirely to misconceive the economics of power practice, and to lose all sense of proportion. There is no virtue in electricity, *per se*, that renders it possible to transmit it economically, except where the cost of power at the generating station is seriously below the cost at the point of consumption. Except for the one item of the blast furnace, this condition is absent in Lancashire, because the Lancashire mills are where they are because the coal pits are there.

The hope for electricity lies in this direction, and the recent putting to work of a gas engine to drive a spinning mill may have an effect beyond present appearances if it shows that the large gas engine can be depended upon. The cost of power is closely considered by the cotton spinners, but it is not put before reliableness. Lancashire mills have no spare plant beyond one boiler, which is laid off in its turn with the others for cleaning. Yet stoppages or hitches are extremely rare. Even if cheaper, there would be an uphill fight for transmitting electricity pending the time when its present stoppages and uncertainty will be overcome. But even when this time has arrived there can be no appreciable improvement upon the conditions already prevailing with rope driving, so that price will ultimately decide the issue unless it can be clearly and unequivocally shown that electrically-driven machinery can actually, as claimed, be run so much faster on the same wear and tear and waste production, than the machinery in a modern rope-driven factory. Messrs. Brown, Boveri and Co. seem to be pointing a direction of promising effort, which is of particular value in connection with electrical driving. It is, of course, the fashion to sneer at rope driving, and to make great claims for direct connection, but this has been much overdone. Of seven electrical stations, the records of which have been much in sight, one had rope-driven dynamos of an old and obsolete type. The rope arrangement was inferior. Yet this one station gave less trouble than any of the others, all of which were direct connected. No good will be effected by the electrician who tries to prove to a cotton spinner the lack of reliableness of ropes. The attempt will be regarded rather as covering a feared failure of the electrician himself.

Estimate No. 1 for Power Plant of Cotton Mill, 110,000 Spindles. Bolton Counts.

Mechanical Rope Driving (a).

Capital outlay—	
Engine, 1,500 I.H.P., piping, &c.	£4,765
Four 30 ft. × 8 ft. × 160 lb. boilers and superheaters	2,400
Boiler house piping	600
Boiler seatings and chimney	1,000
Reservoir (not always needed near a canal)	1,500
Engine house	600
Engine bed	500
Rope race	500
Boiler house	400
Economisers, dampers, engine	700
Lighting generator, 75-KW. pilot engine and foundations, &c.; generator, switchboard, and wiring, &c., 1,200 lights	1,450
Gearing	2,970
Cotton driving ropes	450
15-ton hand crane...	300
Staging and stairs in rope race	300
	£18,435

Running costs (a); year of 50 weeks.

Coal, 3,850 tons at 12s. 6d.	£2,406
Wages—Engineer, 55s.; oiler, 25s.; two stokers, 50s. ...	325
Oil and stores	100
Insurance—Engine, £80; boiler, &c., £33; gearing, £60; buildings, £20	193
Rates, 7s. on 5 per cent. of £18,435	323
Interest and depreciation, 12 per cent. of £18,435 ...	2,212
	£5,559

Equal to 0·477d. per KW.-hour.

Estimate No. 2 for full Electrical Installation at Mill.

Electrical Driving (b).

Capital outlay—	
1,000-kw. turbo-generator and condensing plant, &c....	£6,600
Four 30 ft. × 8 ft. × 160 lb. boilers and superheaters	2,600
Boiler house piping	600
Boiler seats and chimney	1,000
Reservoir (not always needed near a canal)	1,500
Generator house	400
Generator bed	300
Motor tower and carriers	250
Cables and switchboard and motors	4,000
Boiler house	400
Economisers, dampers, engine	700
Pilot engine and generator, switchboard and wiring for 1,200 lights, foundations, &c.	1,150
Mill gearing	1,830
	£21,330
Add for 75-kw. lighting set, since it is not satisfactory to run lights off same three-phase generator as power, say	560
	£21,890

Running Costs (b).

Coal, 4,300 tons at 12s. 6d.	£2,690
Wages—55s.; assistant, 25s.; two stokers, 50s.	325
Oil and stores	75
Insurance—Generator set, £110; boilers and pipes, £33; gearing, £40; buildings, £15; motors, £60	258
Rates, 7s. on 5 per cent. of £21,330	373
Interest and depreciation on £21,330 at 12 per cent. ...	2,560
	£6,281
Equal to 0·534d. per unit.	
Add for cost of 75-kw. combined lighting set, £560 at, say, 15 per cent.	84
	£6,365
Equal to 0·541d. per unit.	

Estimate No. 3 for Supply of Electricity from a Public Supply Station at 10,000 Volts.

Electrical Driving (c).

Capital outlay—	
Boiler, pipes, pump, for heating	£600
Chimney and boiler seating	250
Transformer house...	300
Motor tower and carriers	250
Motors, cables, switchboards	4,000
Transformers (a spare set included)	1,000
Boiler house	150
Mill gearing	1,830
Switchboard and wiring for 1,200 lights	900
	£9,280

Running Costs (c).

Coal for heating, 300 tons at 12s. 6d.	£188 0
Engineer's wages, 55s.	137 10
Oil and stores	50 0
Insurance—Motors, £60; transformers, £15; gearing, £40; buildings, £10	125 0
Rates, 7s. on 5 per cent. of £9,280	162 0
Interest and depreciation on £9,280 at 12 per cent. ...	1,112 0
Current on average load of 900 kw. including lighting based on uniform charge of 0·5625d. per hour	5,906 0
	7,680 10
Equal to 0·657d. per unit.	

It is also doubtful if there is much value in the argument that the smaller capital cost of a mill driven from an external source will tell in favour of the outside station. The mill can borrow the capital for its own power station on loan at lower interest than can the power supply company. The power supply company must expend fully as much capital on engines and boilers, not to name the line cost, and its debentures on the heavier sum will carry, perhaps, 6 per cent. interest. To cover this heavier cost, can the power company make any serious use of the machinery after the factory demand has ceased at, say, 6 p.m.? It is very doubtful. The future for electrical driving lies in the endeavour to get from electricity something that cannot be so well gotten out of other methods.

A NOVEL PORTABLE PHOTOMETER.

The incandescent lamp photometer outfit here illustrated has been recently designed by Messrs. Siemens & Halske to allow tests to be carried out in a very simple manner, without the necessity of a dark room, and with any degree of accuracy desirable in practice.

The measuring process is based on the "angle-mirror" method adopted by the Association of German Electricians. The apparatus mainly comprises (fig. 1) three boxes connected by folding accordions, which are folded up when out of use, in order to form a handy and readily transportable parcel (fig. 2).

The central part of the apparatus contains a voltmeter, an ammeter, the photometer screen, and, screwed on top of it, two folding guide-rails, which at the same time receive the millimetre and candle-power scales.

The voltmeter and ammeter are either soft-iron instruments, standardised both for continuous and alternating currents to an accuracy of ± 1 per cent., or "precision" instruments of the Despres-d'Arsonval type for use with direct current alone. These instruments are connected up to the circuit in such a way as to indicate only the current traversing the lamp, and the P.D. between the terminals of the lamp, thus measuring in watts the consumption of the incandescent lamp alone.

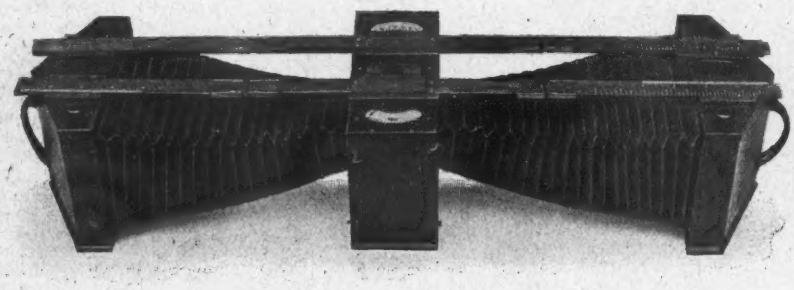


Fig. 1. Portable Photometer.

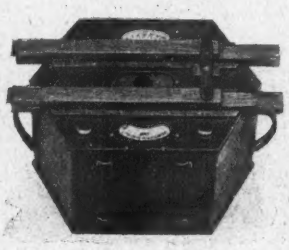


Fig. 2.

This value is obtained from the readings of the instruments by simple multiplication, even in the case of alternating currents, the circuit being practically free from induction and the power factor being nearly equal to unity.

In order to allow the instruments to be checked at any time, or measurements to be carried out by means of precision instruments, special contacts have been provided for connecting such instruments, so that the apparatus can be used for the most accurate laboratory work.

The Bunsen method is used for photometrical tests, but for the grease spot being replaced by a silvered spot between two plates of ground glass. Both the measuring instruments and the scales can be read from the top of the screen, and the screen is likewise inspected from above, which greatly facilitates the operation.

Each of the two lateral parts of the apparatus contains two mirrors, inclined at an angle of 120° to one another, and the standard lamp and the lamp under test respectively. Both lamps are suspended, and the apparatus can be used also in connection with osmium and other suspended lamps.

Measurements can be carried out at any place in full daylight, the apparatus being connected by means of a plug and flexible cord to any ordinary lamp socket. As the standard lamp and the lamp under test are connected up in parallel, the former having in circuit an additional resistance corresponding to the resistance of the ampere-meter inserted into the circuit of the latter, both lamps are subjected to identical voltages, and can be directly compared. In order to allow the candle-power to be determined in the case of circuit pressures above or below the normal voltage of the lamp, the standard lamp can be fixed at a variable distance from the screen, so as to produce the same luminosity as with the normal voltage.

The following table shows the remarkable agreement of photometrical tests, as carried out with this outfit:—

	A.	B.	C.	D.	E.
Candles	10·4	10·2	10·5	10·6	10·2
	10·3	10·5	10·4	10·8	10·2
	10·7	10·6	10·4	10·5	10·5

The foregoing table gives the candle-powers as determined by five experimenters, of whom experimenters D and E, viz., a workman and an office-boy respectively, were entirely unskilled. Three readings were taken by each experimenter.

PROCEEDINGS OF INSTITUTIONS.

Railway Signalling: Its Defects, and Suggestions for Removing Them.

In the discussion of Capt. Gardiner's paper (see Elec. Rev., p. 861), Mr. J. Pigg (of the North-Eastern Railway, Gateshead) said the Gardiner system seemed to be a combination of the track circuit with cab signalling. There was little to be said with regard to the engineering details, for the proposals were so simple as to disarm criticism. The author had only insulated one rail joint, but if the insulation of the joint broke down there was not only an extension of the circuit, but the local battery would send a current through the local relay; the insulation of both joints would be imperative. In practice some trouble would be found by using the same battery for the track circuit and for the cab signals; the disturbing factor was the leakage on the track circuit, which gave rise to the necessity for track relays with a wide range of current strength, necessitating low battery power and low internal resistance. The added resistance, as shown, would form part of the battery resistance for the track circuit. Higher pressure was needed for cab signalling than for the track circuit. He particularly admired the method adopted to prevent a second train obtaining a clear signal when the section was already occupied, but he considered that such a device should not be on the engine, but should be such as would reduce the potential of the contact rail behind any train in the section, so as to make the giving of a second signal at any distance behind that impossible. The ramp was a valuable indication to the driver, and a similar arrangement would be most valuable at what were now distant signalling points. Drivers did not know their locality, in fogs, to within a few hundred yards. For main line work with speeds up to 70 miles an hour, half-mile sections would be unthinkable, and a heavy train with a 100-ton engine, and, say, 350 tons behind, could not be braked at such speeds in these distances. Continuous signalling required in this system continuous contact with the contact rail. Such contacts required to have very low resistance, on account of the low electric pressure available. The brushes must, therefore, clean the contact rail in passing over it, and this would involve considerable heating and enormous wear. He considered that having provided the necessary signals on the engine, where they were under the observation of two men, the driver should be left to handle his engine himself. He had no faith in automatic records, which would add another terror to the locomotive superintendent's life. The probability that they would be available after a serious accident was very remote. One point in which automatic systems failed was that of selection. They could only be of use on the straight through sections shown by the diagram, which were the exception in this country. Captain Gardiner proposed to take away man's liability to error as a signalman, and at the same time, his power for good. With an automatic system, the driver must obey the signals given him, and that was all he was required to do now. Where there was no independent check upon the movement of an engine, such as was afforded by the presence of a signalman, the fear of the consequences involved in passing a signal at danger was reduced. Disasters had occurred, and perhaps would continue to occur, on railways owing to lapses of human control; but these lapses were an infinitesimal proportion of the total operations. Let them provide whatever facilities were possible to check lapses, to enable proper signals to be exhibited, or to enable the driver to know what he was required to do. Having done that, let them leave the man to do his part.

Mr. W. C. Acfield (Midland Railway, Derby) said it was important that the drivers should have some warning, say, at least three-quarters of a mile before a junction, and, therefore, the ramps should be carried right out as far as the distant signals. With regard to the question of reduction of speed, he did not think that any railway company would be prepared to rely on an automatic device, because it would be practically taking the responsibility out of the hands of the drivers.

Mr. E. C. Buck (Railway Audible Signal Co.) said that the home signal denoted a definite geographical point upon the line, and should this landmark be replaced by a cab signal, it would be impossible to distinguish the position of any one point from any other. The home signal was maintained at a small cost, and was the signal least likely to fail. Under Captain Gardiner's system it would be possible for any driver propelling, instead of pulling, a train, to pass the whole of his train into a most dangerous zone, before becoming aware of the fact, by a signal in the cab. He believed that the ideal system would be found to be the right admixture of cab signalling, semaphore signalling and ground control of the brakes. The cost of maintenance of the distant signal was excessive, and the number of wrong indications given by one distant signal in a year was surprising. The management of the Great Western Railway were replacing the distant semaphore signal by an efficient audible and visible cab signal. In reference to the "reduce speed" indication, the audible signal in place of the distant semaphore could be very well used for this purpose. Doing away with the distant semaphore would leave one semaphore only—a stop signal—upon the road; at night there would be only one red light instead of two for the driver to pick up. The system cited above was equally well adapted for single and double-line working. In his report to the Board of Trade on the very serious accident which happened at Shrewsbury, Colonel Yorke clearly indicated the advisability of some form of cab signal, giving distant signals for "safety" and "danger," and also the operation of an automatic brake on the train should a danger signal be received.

Mr. J. Sayers (Midland Railway, Derby) said that the track-circuit controlled signal was a safe signal when used to break up long sections of straight running lines without connections, but was not, in his opinion, a safe signal to be used, whether as a semaphore, or as a cab indication, when a man was running at high speed through junction connections. Any continuous automatic signalling system should have the adjacent track-circuits divided by a short length of track with the two rails short circuited, so as to prevent leakage from one joint to another. Allowance would have to be made for such things as side-play, super-elevation and margin, and it would be found very difficult to put on a modern locomotive five shoes or collectors wide enough to make a reasonable contact at any speed, to stand the side play, &c., and not to foul the wrong collector.

Mr. C. M. Jacob (Great Western Railway, Reading) said that Captain Gardiner suggested that an element of danger was introduced because the G.W.R. distant cab signal was different in form to the semaphore stop signal, but that was an advantage, making a distinction between distant and stop signals. It was because they thought that the cab signal could not perform one important function of the semaphore stop signal that they had retained the latter. A post could carry a semaphore arm, and so give direction as well as location, whereas a cab signal could only give direction. He could hardly agree with Captain Gardiner that manual signalling was deficient in safety compared with track circuit signalling. With regard to speed reductions and route indications, it was doubtful whether it was desirable to introduce so many kinds of signals into the cab of an engine. The most important signal was the distant, and if this signal could be correctly indicated on the train, that would appear to be going as far as was necessary in the direction of cab signalling.

Mr. E. A. Bowden (Great-Western Railway) said that Captain Gardiner's very excellent paper was one of the best he had heard. As to the capital cost involved, Captain Gardiner stated that it would cost about £160 per mile for the automatic arrangement and something like £40 or £60 for each engine; as they had about one engine per mile of track, it would amount to about £200 per mile, a rather serious amount in these times.

Mr. F. Downs (Great Northern Railway, Retford) said that if they could provide a continuous signal from the distant right up to the "home" signal, they would have gone a very large step in helping the driver to identify his situation on the line, and to ascertain if it was "clear" in advance. The ½-mile track sections suggested would be far too short for fast-running trains to be able to stop, and if the sections had to be extended very considerably, then, with leakage from one track to another, was there not a risk of the relay apparatus failing to work correctly, and running the battery down? A track circuit only 500 yards long on the G.N. Railway gave as low as ·8 of an ohm insulation resistance.

Mr. T. Harding Churton (Leeds) said he quite agreed that the failure of the signalling apparatus should have the effect of stopping the train, but thought that in wet weather, owing to leakage, this must result in many trains being held up unnecessarily, disorganising the traffic.

Capt. Gardiner, in reply, said the single insulating fishplate was actually in use on the District Railway in London; but there was not the slightest reason why the other rail should not be insulated too. Also, if two batteries were preferred they could be used. One advantage of continuous signalling over intermittent signalling was that, should any change occur between the first and the second signal, it was immediately shown to the driver; in intermittent signalling they must combine the cab signal with an external signal. The lengths of the sections would have to be fixed according to the requirements of the operating departments, and would depend entirely on the conditions of traffic. The record would be made on a roll of paper wrapped up in a strong box, and there was no reason why this should not be available after an accident; it would be a time record as well, and it would be possible to see what the signal had been, up to the time of the accident. Apart from accidents altogether, they were enabled by it to watch the working of the traffic. As regarded selection, at places where there were points, it would be necessary to retain the signalman, who would decide which train was to have precedence. The signal decided upon would be automatically given on the loco, and would be automatically controlled to prevent a signalman pulling over a wrong lever. Automatic signalling was working very satisfactorily on the London and South-Western Railway, and on the District Railway; on the latter it would be impossible to work the present traffic with any system of manual control. The ramp could be wherever desired. The driver would soon learn to prefer a signal that he could always see, to one which very frequently could not be seen, and which at best required years of learning before it could be correctly interpreted. On this system no overlap was needed; the automatic action came into play sufficiently far back to ensure the train pulling up before reaching the occupied section. The actual voltage and the description of insulation required could only be settled in practice. Published figures had put the cost of the Salisbury accident alone as close upon £100,000; this sum would go a long way towards installing automatic signalling. As regarded cost, comparison, of course, could only be made of an automatic cab signal with other modern automatic outside semaphore systems, which all involved electric track circuits. A primary signalling equipment consisting of "clear," "stop," "danger," and "reduce

speed" indicators, with the necessary contacts, &c., could probably be fitted at a rough estimate for about £20 per engine, which at 0·4 of an engine per mile worked out to £8 a mile. Fully equipped with train control as proposed in this paper, the track work between stations, with ½-mile sections (instead of 1 mile, as with the semaphore), need not exceed from about £140 to £160 per mile, and the engine equipments from £40 to £50. The cost of the track work at stations would be little, if at all, in excess of present requirements.

Having answered other points that had been raised in the discussion, Capt. Gardiner demonstrated the working of the system by means of a model made by Messrs. Accumulator Industries, Ltd., of Woking, showing how a wide range of requirements was provided for by the system.

Institution of Electrical Engineers.—Dublin Local Section.

On Thursday last week Mr. G. F. Pilditch, chairman of the Section, delivered his inaugural address, on the subject of electricity supply in residential districts. The load factor in such areas could, he said, be improved only by the extended use of electric heating and cooking apparatus, especially the latter; but progress in this direction was hampered by the high initial cost of the utensils. The cost of wiring for cooking purposes was trifling, the apparatus being usually confined to one room—the kitchen. The long services required by suburban houses were disproportionately expensive; in Rathmines the average length of cable per house was about 55 ft., and the cost of services on the solid system was about £7 each, while the average revenue was only £6 per annum. By using armoured cable laid direct the cost had been reduced to £5 10s., but a cheaper system was wanted for small consumers. When a row of cottages was supplied from one service, each consumer concluded that his meter was registering some of the electricity that was used by his neighbours, and trouble followed.

Publicity was essential to the securing of new business. The distribution of circulars had proved a failure at Rathmines, but since the meter readers had been deputed to canvass, on a system of payment by results, good progress had been made. The magazines that were issued by some undertakings had a cumulative effect, and it was desirable that they should be made available to the small undertakings, on the co-operative principle. The author did not believe in local exhibitions; permanent showrooms, supported by local contractors, and utilised also as inquiry offices, were preferable, and could be used to demonstrate the advantages of electric cooking.

Short tenancies were a great obstacle to electric lighting progress. Cheap installations put in on a rental basis would help, but Parliamentary powers were necessary to enable local authorities to raise loans for this purpose; he hoped a general Act would be passed to confer the right, subject to the sanction of the L.G.B. Arrangements with companies were unsatisfactory, though if he had power to raise the money, he would recommend that the work should be done by private contractors.

For lighting purposes Mr. Pilditch preferred a flat rate, without restrictions as to maximum demand. As regarded metallic-filament lamps, he believed that consumers would use more light in future, and their consumption would not materially diminish; moreover, new consumers would be obtained. Raising the price of energy would be a great mistake. None of his private-house consumers had changed over entirely to metallic-filament lamps; a few shops had done so, but out of seven examples cited three showed practically no reduction in consumption, two showed a decided increase, and in only two cases had there been a marked decrease, while these consumers had been of immense service in attracting new ones, and recapturing former consumers who had given up carbon filaments and gone back to gas. The efficiency and constancy of candle-power of metallic-filament lamps rendered them very suitable for lighting side streets.

Institution of Electrical Engineers.—London.

As mentioned in our last issue, the usual business of the first meeting of the session, including the presidential address, was adjourned on the 12th inst., owing to the death of Prof. Ayrton, which occurred on the preceding Sunday.

The President briefly referred to the loss sustained by the electrical profession; almost since the Institution was formed, Prof. Ayrton had been one of its mainstays. He was elected a member in 1872, and after 20 years became its president. For some years he filled the office of treasurer, and the sound financial position of the Institution was largely due to his efforts. The Institution *Journal* was a monument to his work, although it contained but a small portion of it; his name was coupled with 32 papers, and he had spoken over 100 times at various meetings. They lost, by his death, one of the small band of eminent teachers who had done so much to establish electrical engineering on a firm foundation, and their last thought should be one of thankfulness for his life.

Prof. Perry, whose lengthy collaboration with the late Prof. Ayrton is too well known to need more than mention, referred to his meeting with him in Japan, to the magnificent laboratory he founded there, to his untiring and feverish energy, and to his intense love for the Institution. Ayrton had, on his return to England, founded fine laboratories at Finsbury and South Kensington—the latter being probably the best of its kind at the time. When in 1878 Ayrton started the classes of the City and Guilds Institute, his success was no doubt partly due to there being so few other classes of the kind; it was almost the only school of electrical engineering in existence. His students learnt by "doing," rather than by listening. He (Prof. Perry) questioned whether many people recognised what a revolution in teaching Ayrton had made; his methods had been adopted in nearly all colleges—not only in the teaching of electrical, but also of mechanical, engineering. In conclusion, Ayrton was a pioneer, and delighted in his work; he was despondent towards the end, because his failing body was not equal to its daily task.

Subsequently a resolution expressing condolence with the family of Prof. Ayrton was adopted, and the meeting then terminated.

The Selection of Turbo-Alternators.

By M. Kloss, Dr.-Ing.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, November 3rd*, 1908.)

New inventions must be judged by standards other than those applicable to the old. Specifications for turbo-alternators frequently embody conditions that used to apply to low-speed machines, but are impossible of fulfilment in this connection; ventilation, voltage regulation and power factor in particular are here dealt with.

Ventilation.—While the output of a machine increases approximately as the cube of its linear dimensions, the radiating surface increases only as the square, so that a time must come when the surface is no longer sufficient to dissipate the heat produced by the losses in the machine. In the case of turbo machines, moreover, owing to the high speed of rotation, the output is enormously greater for a given size of machine, and the losses are correspondingly great. Thus a low-speed alternator of 2,000 kw. has a volume of 31 m.³, and a surface of 112 m.², with total losses about 100 kw.; a turbo-alternator of 6 000 kw., on the other hand, has a volume of 22·4 m.³ and a surface of 45 m.², while the losses are 250 kw., the radiating surface per kw. being, therefore, less than one-sixth. The high-speed machine must also be enclosed to reduce noise, aggravating the conditions, so that the disposal of the waste heat becomes a serious problem. Up to 3,000 kw., a strong draught through the machine, produced by the rotors, suffices, but in larger sizes it is necessary, in order to keep down the temperature not only of the machines, but also of the engine room, to make special provision for dispersing the heat.

On a hot day, with a difference of 9° C. between the temperatures inside and outside the engine room, for every 250 kw. lost inside the room 20 cb. metres of fresh air per second must be introduced, even allowing for the escape of 50 kw. through walls, &c. It is better to take the air direct from the external atmosphere through the machine, allowing a rise of 25° C. in the temperature of the air, when only 9 m.³ of air per second is required, so that a material saving in capital outlay and running cost can be effected. At the Stuart Street station of the Manchester Corporation, the new 6,0(0-kw. Siemens-Willans set is ventilated in this way. The air is filtered before passing through the machine, and can be used afterwards for heating buildings or feeding the boiler furnaces. The machine has a lower temperature rise, is quieter and has an improved appearance when thus ventilated.

Voltage Regulation.—To obtain the greatest possible output at a minimum cost of manufacturing, the greatest possible magnetic flux must be employed, with as many ampere-turns on the armature

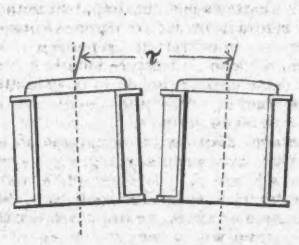


Fig. 1.—60 Poles.

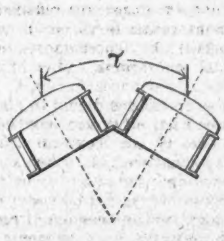


Fig. 2.—6 Poles.

as possible. The latter quantity determines the armature reaction and, therefore, the voltage regulation; to keep this within reasonable limits, the short-circuit current with no-load excitation is usually made equal to 2·5 or 3 times the normal current, and, therefore, the no-load excitation ampere-turns on the field-magnet must be 2·5 to 3 times as great as the full-load ampere-turns on the armature. In low-speed alternators there is plenty of room between the poles for the large amount of copper required on the fields, owing to the small angle between adjacent poles (fig. 1), but in a six-pole turbo-alternator with the same pole-pitch (fig. 2) the winding space available is only about one-quarter as great. Consequently the heat limit of the field is soon reached, and the output of turbo-alternators is never limited by the stator but always by the rotor. It is not possible to obtain the same number of ampere-bars per centimetre, and therefore the output per cm. circumference must be reduced, increasing the price per unit of output; to limit this increase in price, the short-circuit current is reduced, so that the armature ampere-turns per cm. need not be reduced in the same ratio as the field ampere-turns, and this involves sacrificing something of the regulation of the machine. It is commercially impossible to obtain

the same regulation with a turbo-alternator as with a low-speed machine. As the result of the author's investigations, in the case of a 1,000-KW. machine with a normal voltage rise of 6·2 per cent. for unity power factor and of 17 per cent. for cos $\phi = 0{\cdot}80$, the reduction of these values to 4·5 and 14 per cent. respectively would involve an increase of at least 13 per cent. in the cost of the machine. Fair figures for turbo-alternators are:—

5 to 7 per cent. for unity power factor;
13 to 15·5 per cent. for cos $\phi = 0{\cdot}90$; and
15 to 18 per cent. for cos $\phi = 0{\cdot}80$.

Power Factor.—A machine is often ordered for a lower power factor than actually obtains at the station for which it is destined. For example, a 1,000-KW. alternator may be ordered for a power factor of 0·70, whereas the actual power factor is 0·80. The output of the standard machine will be reduced to 79·2 per cent., and the price per kilowatt will, therefore, be increased by 26·5 per cent., under the stated conditions. The owner, working with a power factor of 0·80, will get an increased output of 14·2 per cent.; but as the cost of the machine is 26·5 per cent. more than it need have been if properly specified, he really pays 10·7 per cent. more than is necessary for the actual conditions. As probably the next larger standard machine is supplied, instead of a special design, he probably pays a still higher price.

The exact measurement of the power factor is very difficult, and an error of 1 to 2 per cent. is easily made; if it be 0·78 when it is supposed to be 0·80, an increase in the voltage rise of 0·7 per cent. of normal voltage may result. This possibility is still more important when testing a machine at unity power factor; if the true power factor were 1 per cent. low (0·99), a voltage rise of 8·9 per cent., instead of 6·9 per cent. would be recorded, in the case of a typical example cited by the author. The allowance made in specifications for possible errors in measuring the various quantities should, therefore, be still greater for the non-inductive load tests than for the tests at lower power factors.

Discussion.

Mr. A. H. Law said the points the author had brought out had never been recognised by the ordinary purchasing engineer. He had recently seen one of the 6,000-KW. sets running at Stuart Street station, and the ventilating arrangements seemed open to criticism; apparently the cold air passed inwards through ducts, first through the stator iron, which was not very important, next through the stator copper, which ought to be kept as cool as possible, and finally through the rotor, which above all other parts should be kept cool. In fig. 2 the author showed that the V-shaped groove was entirely wasted, but it was of great value, since it could be used for air passages. At Carville station an alternator was at first self-ventilating, and had an output of 3,500 to 4,000 KW. Motor-driven fans were afterwards installed to blow the air in at each end of the rotor and along the rotor and radially outwards. This had resulted in an increased output, and in a paper read by Mr. Mers he rated the machine at 6,000 KW. To put in forced ventilation for machines under 500 KW, and running at 3,000 R.P.M., was absurd. Voltage regulation limited the output of machines almost entirely. A method of compounding had been devised by his firm, enabling alternators to be designed for fairly high voltage regulation; the method might be described as an exciter compounding arrangement. The leakage coefficient of the exciter was increased by means of iron leakage parts; these carried coils which were in series with the main current, or excited by current obtained from current transformers. When the load came on to the alternators, the leakage flux through the leakage parts was stopped and diverted through the exciter armature, thereby raising the voltage of the exciter and compensating for the load on the alternator. In large turbo-generators where the pole pitch was a quarter or half the circumference, it was always a matter of difficulty to support the end windings. This was best remedied by designing the machine for a heavy drop, and compounding to bring back the voltage to the normal amount. He was in perfect agreement with the author on the question of power factor. If an engineer wanted a margin, it would be much better to specify that margin in asking for a low temperature rise.

Mr. Seaton said that it was quite the custom in the engineering trade that when trouble arose the commercial man was first of all sent to deal with it. Quite recently he had a complaint from a well-known Yorkshire engineer, "Would I please attend to my men, as they would insist on grilling kippers on the alternators."

Mr. J. S. Peck said that with external ventilation, if the temperature rise proved too high, it might be advisable to speed up the blower or put in a larger cooling set. Such a course should be avoided, as the power required for cooling went up as the cube of the air delivered, whereas the cooling itself went up much more slowly than the amount of air supplied. At the Chelsea generating station there were eight 5,500-KW. alternators, all of which were self-cooling and within the guaranteed temperature limit. Practically everything claimed for external ventilation applied to an enclosed self-ventilating machine which drew its air from the outside of the building. He felt sure that self-ventilation would gradually become standard practice on machines up to the largest capacity now used in this country. The fluctuations in the load of large machines were not very great or very rapid, therefore fine regulation was not of great importance. The one occasion on which the sudden change in the load occurred was on a short circuit, when the poorer the regulation the less was the damage. The practice was growing of installing machines having rather poor regulation and providing them with some form of automatic regulation. In that respect Mr. Walker's system of compounding an alternator was of great value, since it held a constant voltage for ordinary load fluctuations, but in the event of a short circuit, where the power factor was very low, it gave poor regulation, and consequently the amount of damage was small.

Mr. S. J. Watson said that some system of taking the air from outside and discharging it outside the engine room must become standard practice.

Mr. J. Frith thought a false distinction had been made between artificially-cooled and self-ventilated turbo-machines. In the latter the fan was simply mounted on the rotor shaft instead of on a shaft somewhere else. He believed that a good deal could be done by putting compressed air into a turbo-alternator. The air was cooled and the heat carried off in a far more useful form in hot water, and the air in expanding in the generator case cooled very much, which would keep the machine working at a much lower temperature, and, therefore, at a higher efficiency. Was the temperature of the surrounding atmosphere that of the outside air, or the engine-room temperature? If the purchasing engineer wanted a margin, the best thing to do was to specify a larger machine than he really wanted.

Mr. J. R. Salter said he should have called the paper "Practical Considerations for the Rejection of Turbo-Alternators." As compared with a reciprocating set, the turbine generally had a lower price, but if the extra losses were taken into consideration, due to the necessity of obtaining a high vacuum or for superheat, and capitalised, it would be found that there was little difference between a turbine and a reciprocating set, except as regarded floor space. When fans, &c., had to be installed to keep the machines cool and reduce their output, they must seriously consider whether they ought not to compare the cost of the turbine and the reciprocating set, taking into consideration the losses due to the turbine, and it would be found that except for space there was not so much advantage in a turbine.

The Chairman (Mr. Miles Walker) said that the efficiency of a turbo-generator was much higher than that of the ordinary reciprocating set, and one could obtain as good regulation on a turbo set as on an engine set. He did not agree with Dr. Kloss's statement that the rotor temperature limited the output. He thought the future would show that large machines would be ventilated by forced draught in all big stations.

Electric Propulsion of Steamships.

At a meeting of the Institute of Marine Engineers, held on November 2nd, the adjourned discussion took place on Mr. W. P. Durtnall's paper on "Electric Power for Marine Propulsion." It was evident that the members present had not very thoroughly grasped the principles involved in Mr. Durtnall's proposal, with the result that the discussion was not quite so animated as it might otherwise have been. Thus, the first speaker, Mr. Farrington, said he did not see how, by introducing additional mechanism, a gain in efficiency could be effected. In the one case, they had the boiler, the marine engine and propeller, whereas, in the other case, they had the boiler, the turbo-generator, the motors and the propeller. In his opinion, the greater the number of parts, the greater would be the loss; he failed to see, therefore, how any economy in coal consumption could be effected, and this was the all-important item.

Mr. Simpson could not see that there was very much difference between land and marine work, and as the electric motor on account of its high efficiency was being used more and more on land, he quite thought that the time would come when eventually it would be largely used at sea. He asked if there was any possibility of driving ships by Marconi waves, and so dispensing with the boiler altogether!

Mr. Redmond asked the author for a comparison between electrical driving and the ordinary marine engine method in the case, say, of a 3,000-H.P. engine running at 60 R.P.M. with a 15-ft. propeller. What he wanted to know was what saving could be effected, and what would be the size of motor and propeller, the speed, and any other data which the author could give.

Mr. Frank Broadbent was of opinion that the previous speakers had failed to grasp the essential principles of the author's proposal. He would regard it as electricity gone mad if the proposition were to retain the marine engine of the reciprocating type, and to interpose between it and the propeller an electric transmission system. This, he pointed out, was not the method proposed. It was the adoption on board ship of the steam turbine, which was essentially a fast-speed machine, which had given rise to new conditions, and had made the economical use of electric transmission possible. From the propeller point of view, low speeds were desirable; but in order to get the best economy from the combination the propeller had to be run at higher speeds than were conducive to economy, and the turbine, on the other hand, had to be run below its most economical speed. The interposition of the electrical gear permitted both turbine and propeller to run at their best and most economical speeds. Touching on the electrical equipment, Mr. Broadbent said that whilst the continuous-current series-wound motor had a speed-torque curve which was particularly well adapted to road transmission, the opposite was the case for marine propulsion, where the speed-torque curve of the induction motor corresponded very closely with the speed-torque curve of the propeller.

Mr. Dean had hoped to hear something about propeller speeds and efficiency from the marine engineers, as it appeared to him, judging from the performances of some of the large vessels, that the propeller efficiency must fall off as the speed increased. Thus, comparing the *Deutschland* with the *Lusitania*, he believed that the power on the turbine-propelled ship was much greater than on the *Deutschland*, yet the coal consumption was about the same. He

referred also to the possibility of using internal combustion engines on board ship, in which case the electrical drive would solve a good many difficulties which the internal combustion engine introduced.

Mr. Robinson thought that the results obtained by steam turbines on board ship did not justify their general adoption in preference to piston engines. In criticising Mr. Durtnall's paper, he said that 10 per cent. was not too much to allow for the electrical transmission gear, and the figure should be more like 15 per cent. He also asked for the relative capital outlay of the proposed system as compared with the existing method. Another important point was reliability; how would the motors act in very rough weather when the screw was sometimes out of the water?

Mr. Willis was of opinion that any new method proposed should not be compared with existing methods, but with other proposals which might be adopted in the future, such, for instance, as the combination of the piston engine with the turbine.

Mr. Hollis, who claimed considerable experience with steam turbines, said that the improvements which were being made in turbine design would enable them to get down to 12 lb. of steam per kw.-hour in the very near future. Marine conditions were far better than land conditions so far as power factor was concerned, as there was a fairly steady load on the generators. He spoke also of the reliability of induction motors, many of which were working in shipyards year in and year out without any attention except lubrication.

The Chairman (Mr. James Denny) agreed with other members that marine engineers could not be expected to rush into these new things. There was nothing yet to show that the turbine was so very much superior as to induce them to go in for such a revolutionary change. In the case of a fire such as was recently experienced on one of the Underground Railways, a panic might easily be caused on board ship, and he would like some kind of guarantee as to the immunity from fire of the electrical equipment. He further considered that electrical engineers would have to be prepared to guarantee definite savings in consumption before shipowners or builders would consider the matter.

The Secretary also spoke to much the same effect, and suggested that another evening might be well devoted to the subject now that the matter had been opened and a little more light thrown upon it. This was eventually agreed to.

In his reply, Mr. Durtnall said he would have liked to hear the engineers criticise his figures of weights and dimensions, which he had only been able to arrive at from published data and not from actual experience. He confirmed his own figures as to steam consumption, and said he had a definite guarantee from a steam turbine maker of 11 lb. per kw.-hour including auxiliaries for a 12,000-h.p. set running at 750 r.p.m with 160 lb. steam pressure, 100° superheat and 28 in. vacuum. This he pointed out would mean about 8·8 lb. per shaft h.p. Replying to Mr. Redmond, he considered that with electrical equipments the propeller need not be kept down to a low speed such as 60 r.p.m. This speed was really due to the limitations of the marine engine and not of the propeller. It would be possible to run a propeller of this power at about 200 r.p.m. Touching upon internal combustion engines he pointed to the difficulty of reversing the engine whilst the ship was in motion, and also to the difficulty of speed variation. As to the cost of this proposed system, he estimated that about £4 to £4 10s. per kw. would cover sets of from 4,000 to 5,000 h.p. He reserved any further remarks until the adjourned discussion, which will take place in January.

Progress in Radiology.

At the November meeting of the Röntgen Society, Dr. W. Deane Butcher delivered his annual presidential address, taking as his subject the year's progress in radiology and the allied sciences. He was the delegate of the Society at the recent fourth international Congress of X-ray workers at Amsterdam, and he summarised the physical, as opposed to the strictly medical, aspects of that Congress. The chief advance of the year, he said, was undoubtedly in instantaneous radiography, and in this direction, judging by what he saw at Amsterdam, the American radiologists were easily first. It was now possible to take a life-size portrait of the whole of the abdomen, with an exposure of half a second. This instantaneous exposure caught the stomach in the very act of contracting, while an exposure of a second would just miss this phenomenon. As the source of their current the Americans used static machines of great power. In some cases their machines had 50 plates rotating on a vertical axis. The disadvantages of the static machine were its terrific noise and the danger of the plates flying to pieces. He suggested that a means might be found for relegating the machine itself to the cellar, and having a chimney-like arrangement to communicate with the workroom. The Snook generator was highly praised at the Congress. It consisted of a motor-dynamo producing an alternating current, the high-pressure secondary current being rectified by a rotating pole-changing switch. The prettiest thing in the Congress was the modification of the Einthoven galvanometer by Prof. Wertheim Salomonson, of Amsterdam. The principle of the instrument was as follows:—A silvered quartz fibre carrying a small current was stretched in a strong magnetic field. As soon as the current was switched on the wire sagged in a direction perpendicular to the magnetic lines of force, the displacement being observed by means of a microscope. The most interesting use to which Prof. Salomonson had put this instrument was in the production of electrocardiagrams. The heart gave an action current with every beat. Both hands of a person were connected to the terminals of a galvanometer by means of unpolarisable electrodes, and oscillations synchronous with the heart-beats were then obtained. The tracings showed distinctly that the heart gave five separate actions with every beat. Dutch electricians, said Dr. Butcher, though few in number, were no whit behind others in technique.

Dr. Butcher expressed his gratification on taking the chair of the Röntgen Society, in succession to Mr. W. Duddell. The Society, he said, was unique in being a bond of union between the medical, physical and mechanical societies, welcoming with equal cordiality the physician and the physicist, the amateur, the inventor and the manufacturer, as well as the radiologists of England, America and the Continent. Radiology was in a fair way to becoming an exact science, and they were looking forward to the day—nearer, perhaps, than some of them thought—when the focus tube would be as familiar as the stethoscope in the hand of the medical practitioner.

PARLIAMENTARY.

London & District Electricity Supply Bill.

Wednesday, November 11th.

Mr. J. Conacher, general manager of the Metropolitan Electric Supply Co., gave evidence as to the commercial position of the companies and the restrictions under which they now worked. He contended that the scheme of the promoters would not be of any material benefit to the consumers of London. The present companies were well able to deal with all the demands that might be made upon them for several years hence.

Mr. E. E. Johnson, of the firm of Messrs. O. R. Johnson & Sons, chartered accountants, was called to prove that the figures quoted in respect to the Charing Cross and City Electric Lighting Co., of which he was auditor, were correct.

This closed the case for the companies.

Mr. Gerald Sanders, for the Islington Borough Council, then addressed the Committee. He asked Parliament not to sanction the scheme, as it would be active competition against a local authority which had been doing its duty to all consumers. His Council first considered the question of electrical supply to the borough before the year 1888, but at that time they came to the conclusion that it was not an opportune moment to own their electrical undertaking. They, however, obtained a provisional order in 1893. They supplied energy for lighting only, but in 1902 they obtained Parliamentary sanction for giving a power supply. Every day they were increasing their power supply, and for the past few years there had been a reduction in the prices charged to consumers. He asked that the promoters should not be allowed to compete with Islington unless it could be shown that they were not doing their duty. No evidence had been given that there had been any complaints as to the supply in Islington. His Council did not think that the Kitson Clause in the Bill gave the local authorities sufficient protection.

The Chairman remarked that throughout the proceedings, Mr. Fitzgerald had stated what the intention of the Kitson Clause was, but doubts had arisen as to whether the words had the right meaning. He might say that when they considered the clauses in the Bill, the Committee would hear arguments on that clause, and bring the wording into conformity with what was said to be its intention.

Mr. Sanders, continuing, said there was nothing in the Bill which prevented the promoters, once they got into his area, from raising their prices. He had asked the witnesses whether they were prepared to insert a clause limiting the prices at which a supply should be given, but that had been refused. He claimed that the local authorities should have the right of saying whether this company should come in and give a supply. As to the L.C.C. being the purchasing authority, when that took place, they would have the undesirable position of two bodies competiting with each other with the ratepayers' money.

Mr. Albert Gay, borough electrical engineer to Islington, said that £449,000 had been spent on the undertaking. The present capacity of the station was 5,100 kw., and when the erection of new turbines had been completed, it would bring the capacity up to 6,600 kw. If they extended their works as far as they were able, they would have installed 40,000 kw. To do that would necessitate a total capital expenditure of £900,000, which included the £449,000 already spent—that represented £22 10s. per kw., as against the promoters' figure of £32 per kw. They had 49 miles of cables in the streets of the borough. In 1902-3 they sold 76,673 units for power purposes, as compared with 1,020,475 in 1907-8. For power they charged a flat rate of a penny. He did not agree with the tables put in by the promoters; they were purely hypothetical.

Cross-examined: His estimate of the cost of 40,000 kw. being £22 10s. per kw., was on the assumption that the current would be used in Islington, and not transmitted. In 1909-10 they estimated their works cost would be ·95d. Their cost for coal per unit delivered to the consumer was ·6d. Assuming that the promoters could give them a supply at ·434d., it would be to their advantage to take it. They bought the current for public lighting from themselves. Their load factor for the private power consumer was very good.

Mr. S. Bushe then proceeded with the case for the West End companies: Westminster, St. James', Notting Hill, and Kensington. The area was, he said, purely a residential one, and essentially non-industrial. The principle demand was for lighting, but whatever demand was made for power, was met. The West End companies

supplied 62 per cent. of the total power requirements, and the greater proportion of that unsupplied was of a character which electrical companies could never hope to supply. The companies had erected two bulk stations—one in St. Marylebone and one in Hammersmith. They were, therefore, in a position to deal with all the demands that might be made upon them. In the words of the Board of Trade's report to the Committee, they "were exercising their powers with due regard to the interests of the public with respect to the supply of energy." He deprecated the scheme of the promoters inasmuch as they only had one central station on which the supply of electricity to London might at some date be dependent. Then, again, the promoters could compete with them, without being under the same restrictions as his companies were. It was against Parliamentary precedent to allow a company to compete with authorised undertakers who had been long established. They were not going to give the consumers any direct benefit. He was afraid that in small areas, pressure would be brought to bear on the authorised undertaker in an endeavour to get a consumer. The whole success of the scheme depended upon whether the promoters got the authorised distributors. It really resolved itself into a gamble—a chance—as to whether the scheme would succeed. He did not for a moment accept the figures of the promoters. Even supposing that the sanguine expectations of their engineers were fulfilled, the consumers at some distant date only got the benefit of a reduction of one-eighth of a penny per unit. If the authorised distributors would not come in, what would happen? The promoters would bring pressure to bear upon them. The Bill, unfortunately, would give them power to put illegitimate pressure upon the present undertakers. He asked that the Bill be rejected. Although it was alleged that the scheme had been brought forward to satisfy the public, there had not been a single expression of public opinion in support of the Bill. With regard to finance: First of all, £600,000 had to be found, but that would neither begin or finish anything. What assurance had they that any more funds would be forthcoming?—absolutely none. If the purchasing authority was to be the L.C.C., and the undertaking was acquired before 1931, what would be the position? They would have the remarkable position of the L.C.C. endeavouring to dangerously injure his undertakings, so that, when the time came for them to be taken over in 1931, it could be done at as cheap a price as possible.

Sir Alexander Kennedy, consulting engineer to the West End companies, was called, and corroborated counsel's opening statement. The West End companies, he said, supplied in 1906, 2½ million units for power purposes; in 1907, just over 3 million, and they estimated that this year they would sell 4 million. Their average price was 1·04d. per unit. He did not agree with the estimates of Mr. Hammond. Instead of their effecting a saving by taking a supply from the promoters, there would be a loss of £800. He did not think that the present undertakers would at all care to take a supply from a bulk company, as they had no security over that part of the undertaking.

Cross-examined: The new station which was to be erected in place of the one acquired by the L.C.C. at Millbank, was estimated to cost £600,000.

Mr. Erskine Pollock called Mr. James Bigwood, Chairman of the Parliamentary Committee of the Middlesex County Council, who gave evidence against the proposals of the promoters.

Thursday, November 12th.

Mr. James Bigwood continued his evidence. He deprecated the London County Council being the purchasing authority, as it would tend to one public body interfering with another. Middlesex was supplied by the North Metropolitan and the Metropolitan Electric Companies, and his Council had no objection to those companies taking a supply from the promoters provided the supply was taken within the companies' London area. They had 40 miles of light railways in operation. They had nothing to gain by the Bill, and there was a reasonable prospect of it doing them considerable injury.

Mr. Stephen Sellon, M.I.C.E., said he had been instructed by the Middlesex County Council to examine the proposals of the promoters. He estimated that the cost of distribution would be so heavy, that the cost of supply to Middlesex would be much in excess of the average price in the districts surrounding Barking. The nearest control station for Middlesex from the proposed station at Barking would be at Holland Park, and that was 17 miles distant, and then there would be an additional seven miles to the nearest extremity of Middlesex. He did not think it was economical to deliver current to such distant places. As a result of his examination of the scheme, he did not consider it well laid out. He particularly found fault with the method of using ·35 cables. He regarded the scheme as a whole improbable and uneconomical. In his opinion, 30 years was too great for the life of the cables. He doubted whether Middlesex would form a suitable unit to any electrical power undertaking. The whole question was one of transmission.

By Mr. Fitzgerald: He was aware of a "nest" in Glasgow which contained 40 cables, but that instance could not be compared with any proposal of the promoters, as the pressure on the cables was different.

Mr. Erskine Pollock, in addressing the Committee, said that the first objection of Middlesex to being included in the area of the promoters was the great distance the county was from Barking. The promoters could not efficiently and economically give a supply to places so far away. His second objection was the ultimate purchase of all the powers under the Bill by the London County Council.

The Chairman remarked that the Committee were impressed with the exceptional circumstances of the area of Middlesex.

Mr. Pollock, continuing, said that the Council contended, and the contention was supported by Mr. Sellon, that the proper way to deal with Middlesex was by erecting generating stations—one on the Lea and one on the Thames, somewhere by Chiswick—and in that way any point would be within 10 miles of a generating station. He asked that this scheme should not be allowed to proceed, as under the promoters' powers they would be able to purchase the North Metropolitan Co., and that company would eventually be acquired by an authority over which Middlesex had no control. The Committee could see how expensive it would be to lay mains to supply Middlesex, and the unremunerative character of the County. Passing to the question of the London County Council being the purchasing authority; if the idea of Parliament was that what was situated in London should eventually be acquired by the L.C.C., surely the same principle applied that Middlesex should have control over those things which were in Middlesex. Supposing the company was acquired by the L.C.C., it meant the rates of London being expended on works outside London. If the scheme failed whilst in the hands of the L.C.C., and was not paying its way successfully, the ratepayers of London would feel very much aggrieved, and Middlesex would be subjected to abuse. Supposing the scheme to be a success, they would have the L.C.C. saying that it had been done with London's money, and therefore London should have the advantage of the scheme, whilst as Middlesex had proved such an expense, they could not give them the same benefit. The Middlesex Council would be in that unfortunate position, although they had strongly resisted being placed in the Bill. Middlesex considered they had better prospects as they were now. At some future date they would acquire the present undertakings, and they would then be able to get a better scheme than any which London could offer them.

Mr. Rigg addressed the Committee for the Corporation of London. He said that the Bill was not wanted, it ought not to pass, and if it was allowed to proceed, the promoters should not go into the City either for giving a supply or for the laying of mains. It might be said by the promoters that they wanted to supply the underground railways, but they were already supplied. There was no field for the promoters, and it would be nothing short of a scandal to allow them to lay mains in the City for the supply of current to a point beyond. There had been no evidence that there was an unsatisfied demand for power. He suggested that if the Committee should reject the Bill, they might say that a Board of Trade inquiry should be held to consider the best way of solving the electrical problem of London.

Tuesday, November 17th.

At the resumption of the proceedings, Mr. James Devonshire, managing director of the North Metropolitan Electric Supply Co., gave evidence. He said that his company was incorporated under an Act of 1900. They had since obtained other Acts which gave them further powers. His company had four generating stations, two of which were in the area defined by the Bill. Both these stations could be extended. The capital of his company was 50,000 £100 shares of which 40,000 had been issued. In all they had raised £480,000. They had offered very advantageous terms to two local authorities to take a supply, but neither had done so. The average price for lighting and power purposes was 2·68d. per unit in Willesden. They supplied last year nine million units for tramways and light railways. They gave a supply in bulk to power users. The present Bill authorised unlimited competition with them; the proposal to allow power companies to compete, was quite a new departure, and in his opinion the Kitson Clause was not meant to be inserted to give protection to a power company. Parliament had never permitted competition between power companies. They had a clause in their Acts whereby they could not enter the Metropolitan Co.'s area, without that company's consent, and a similar clause was in the Metropolitan Co.'s Acts.

Cross-examined by Mr. Fitzgerald: The Metropolitan Electric Tramways Co. owned the shares of the Power Co., of which he was managing director, and prior to the formation of that company, a distribution company was formed, of which he was chairman. Their maximum price in their Bill was 4d. per unit. The supply to the Willesden Urban Council was on a sliding scale of charges.

Mr. T. R. Murray, engineer to the company, said that the four generating stations had a capacity of 11,450 kw. The stations at Willesden and Brimsdown had plant installed equal to 8,500 kw. The cost at Willesden worked out at £20·5 per kw. installed, and at Brimsdown, to £23·5. The two stations were connected up by 21½ route-miles of cables laid in duplicate. He considered the interconnecting of stations of enormous importance; the benefits could not be over-estimated. The average cost of their 13 sub-stations worked out at £12·5 per kw. installed. Their operating cost, including capital charges, per unit was ·712d. In two years' time they estimated they would sell 20 million units, and he estimated the works cost at ·451., interest on sinking fund and depreciation at ·12d., making a total cost per unit of ·57d. That figure compared with the promoters' estimate in five years' time of ·414d. per unit.

Mr. Balfour Browne, in his address to the Committee, said he would ask them to say that the Bill ought not to pass, first, because it was absolutely contrary to Parliamentary precedent to allow two power companies to compete; secondly, because in the area he represented there was no necessity for the Bill; and thirdly, because the competition which it would introduce would be injurious to the company and the consumer. Mr. Parshall had said himself that he had no objection to making the Kitson Clause applicable to the North Metropolitan Co. He asked for protection, for in the Board of

Trade Report to the Committee, they said that it should be considered whether in the case of local authorities and companies who had been doing their duty, and were doing their duty, further protection should not be afforded to them. Mr. Browne then referred to six cases which power companies had sought powers to supply electricity in the same area, but Parliament had never sanctioned them. He asked the Committee not to pass the Bill, as he did not think the promoters had any *bonâ fide* intention of supplying them. Competition was not the proper way of enforcing statutory duties, as competition led to combination. His company had already suffered from the promotion of such a Bill as was now before them, as people hung back in the hope of getting the Utopia of prices which were put forward by promoters. If they passed the Bill, he asked them, as a condition of approving the preamble, to say that a supply of any kind should not be given in his company's area without their consent.

Mr. Blennerhassett asked the Committee to say that, if they gave Mr. Browne the veto, it should not be applicable to Willesden.

Mr. H. F. Parshall, recalled, said that they had guarantees that cables could be supplied to stand a density of 1,250 amperes to the square inch. The current density on the cables they used would be 750 amperes to the square inch, and that would only be for six hours a day. He had a considerable knowledge of cables, as he was responsible for £2,000,000 worth of cables laid down by various undertakers. He did not agree with Mr. Sellon that a large number of cables could be put in a "nest." Even supposing it could be done, it would not have such a "skin effect" as had been stated by Mr. Sellon.

Cross-examined by Mr. Pollock: He had no personal experience of laying the 35 cables, which would be used by the promoters underground. There would be a small "skin effect" in his cables. He thought a density of 1,000 amperes was perfectly safe.

Mr. Fitzgerald then made the closing speech for the promoters. He said that the question the Committee had to decide was—was there any need for the Bill? There were 28 Borough Councils within the proposed area, and only nine appeared to oppose the scheme. There had been no opposition from the L.C.C.

Mr. Freeman, for the L.C.C., said they were perfectly satisfied with the Bill as it now stood, but he might have to make one or two observations with regard to the Board of Trade report, when they considered the clauses.

Mr. Blennerhassett said they also agreed with the Bill, but Westminster did not agree with the Board of Trade's suggestion that the L.C.C. should be empowered to purchase the undertaking at any time they pleased.

Mr. Fitzgerald, continuing, said that there were 64 local authorities outside London, of whom 21 were small Parish Councils, none of whom opposed the Bill. Not one of the large centres like East Ham, Walthamstow, Barking, &c., had raised any objection to the scheme. Along the river from Barking to Purfleet on the one side, and to Grays Thurrock on the other, there were large plots of land admirably situated for sites for manufactories, &c., if only a cheap supply of electricity could be given. In the large area of Kent proposed to be supplied, only Beckenham and Bexley had opposed the Bill, but not the Kent County Council. Then, again, in Surrey no one had appeared in opposition except Croydon. With regard to Middlesex, they had the opposition of the Middlesex County Council. Taking the companies, there were 22 in the proposed area of supply, and only nine of them appeared before that Committee to oppose the scheme. The first question they had to consider was—whether the scheme was desirable? He contended that it was necessary that a cheap electricity supply should be given to the enormous area of London and the surrounding district. As they were aware the question had been before Parliament ever since 1905, when Mr. Merz introduced a Bill. If a scheme was desirable, as he contended it was, then he considered that the one now before the Committee solved the problem. The main point of the opposition was that anyone who wanted electricity, could get it more cheaply from the existing undertakings than from any other scheme authorised by Parliament. The companies had said that there was not a sufficient field to warrant the scheme being brought forward. The companies had attacked the figures put before a Committee by Mr. Merz, in which that gentleman stated that there was a possible field of supply of 480,000 H.P. But they, the promoters, whether those figures were right or wrong, did not put them in. The promoters' estimates were based on figures obtained by the L.C.C. That authority estimated that there was a horse-power demand in London of 370,000, and of that 77,000 H.P. was already supplied, leaving 290,300 H.P. In addition, they estimated there was 77,000 H.P. in the adjoining area to London untouched. Mr. Parshall considered that there was 219,000 H.P. within the County of London that was not electrically driven, and outside London 59,000 H.P. still unoccupied, so that they had a possible field of 278,000 H.P. The companies had put Mr. Renwick, of the County of London Co., in the witness box, who had stated that the companies estimated there was only a field of 208,000 H.P. Taking that figure the companies said 135,000 H.P. was unsupplied. That amount added to the 59,000 H.P. outside London gave them 194,000 H.P. still unsupplied. He submitted, however, that the canvas made by the companies was totally unreliable. It had also been stated by the companies that the local authorities had made a canvas, but not a single authority had been called to prove the estimates put in.

Mr. Balfour Browne said that the reason of that was because he understood the chairman to say that they were satisfied with the evidence on that point.

Mr. Fitzgerald, continuing, said that no account had been taken of the supply to railways, and as they had heard in evidence, several of the railway companies would take a supply, if they could get a cheap and reliable one. Then, again, with regard to authorised distributors, the promoters estimated there would be a large demand from them. Not only would the small local authorities take a supply, but he thought the larger ones would also come in.

(To be continued.)

LEGAL.

Fletcher *v.* Nottidge.

In the King's Bench Division on Thursday, November 12th, Mr. Justice Bucknill delivered judgment in this action, which was brought by Mr. Bernard Fletcher, a civil and electrical engineer, against Mr. James Nottidge, of Ashford, Mr. Curtus Burra, of Rye, Mr. Rose Pomfret-Pomfret, of Mystole, Canterbury, and Mr. Frederick Willoughby Hose, of 52, Lincoln's Inn Fields, as trustees of the will of the late Mr. Wm. Pomfret Pomfret, to recover the sum of £315, professional fees and expenses alleged to be due in connection with the installation of electric light at Mystole Mansion, and a scheme for the supply of water there. The defendants admitted that the plaintiff was consulted, and prepared a report, but they alleged that he did so, knowing that it would be necessary to obtain the sanction of the Courts to the expenditure of the money and agreeing to abide by the limitations imposed. The Courts, they pleaded, limited the total expenditure to £1,113 2s 7d., and made an order authorising no greater payment to plaintiff than 5 per cent. on that amount, or £55 13s. in actual figures. Plaintiff had already received £205; £105 was paid in pursuance of a verbal agreement, but not on a general account, and defendants counterclaimed for repayment of £100 and damages, which they alleged they had sustained, in consequence of plaintiffs' failure to prove or complete an affidavit to support their second application to the Court for authority to incur the necessary expenditure to install the electric light.

Mr. Sanderson, K.C., and Mr. Ricketts appeared for the plaintiff, and Mr. Pollock, K.C., and Mr. Norman Craig represented the defendants.

His Lordship said this was a dispute between two gentlemen of high position, and having locked thoroughly into the matter, he did not think there was much in the counterclaim. He was convinced that neither gentleman had tried to deceive the Court, and there was no suggestion that the work had not been done perfectly honestly. He found, as a fact, that there was an agreement to pay the plaintiff 300 guineas, and the only question, therefore, was one of *quantum meruit*. He came to the conclusion that plaintiff was entitled to recover the sum of £244 5s. for work and service done. The plaintiff having received the sum of £205, there would be judgment for the plaintiff for £39 5s. on the claim and for the plaintiff on the counterclaim, with costs.

Westminster Electric Supply Corporation, Ltd., *v.* L.C.C.

The third day's evidence in this arbitration was taken in the Surveyors' Institute on the 13th inst. The L.C.C. desire to acquire the premises occupied by the corporation at Millbank for the purpose of carrying out the Westminster improvement scheme, and they have provided the corporation with a site at Horseferry Road.

Mr. Balfour Browne, K.C., for the corporation, said that since their last meeting they had tried to deal with the question that was raised regarding the subway. Interviews had taken place between both sides, and it had been settled that the subway, which was set aside by the L.C.C. as an impossibility, was not an impossibility at all, but could be accomplished. The subway is to extend from the river bank to the Horseferry works. There were difficulties about water standing at a part of the subway, but, Mr. Browne said, this could be got over, as the corporation were quite prepared to pump the water out and keep the subway dry. The subway was to contain four pipes of 20 in. So far as the subway went it was satisfactory, but what the corporation desired was pipes to the same place out in the river as the corporation had them now. He understood that although the subway reached the river, the pipes did not. The subway proposed to be given by the L.C.C. would cost about £2,000, and the one the corporation desired would cost between £4,000 and £5,000. If the tribunal gave the corporation compensation, their claim would certainly be between £70,000 and £80,000 altogether. The L.C.C.'s offer seemed to be absolutely ridiculous. Motor generating plant at the new premises would come to an enormous sum, but the corporation did not want motor generating plant, they wanted condensing plant.

Sir Edward Clarke, who appeared for the L.C.C., said, assuming that the pipes did not take the corporation to the water, that, he thought, did not constitute equal facilities in the sense of the Act, and the question would be additional length of pipe, or something of that kind. He thought the L.C.C. would be prepared to give the necessary requirements, and Mr. Young, one of the arbitrators, endorsed Sir Edward Clarke's remark.

Sir Alex. Kennedy, of the Westminster Electric Supply Corporation, Ltd., examined by the Hon. Alfred Lyttleton, said that when their existing station was built their ideas of what was

required as regards an electricity station for London was not very great, and the corporation ordered condensing plant for 700 KW. The corporation found that their original idea was much too small, and in 1897-8 they ordered plant sufficient for 5,000 KW. in addition to the old condensing plant. That plant was now in the existing station, and they put four openings in the river wall with the idea of connecting 16 in. round pipes for the use of the condensing plant, but the L.C.C. Act was passed, and in consequence of representations by the L.C.C. not to carry out extensions the pipes were never laid. WITNESS stated that the corporation had lost £11,000 in not having the use of their additional condensing plant. At the new station he considered four 20 in. pipes to be the proper size for their requirements. They were to use the most up-to-date machinery, and he thought the corporation was entitled to four 20-in. pipes because in future they could not lay down additional pipes as the sub-way would not permit them to do so.

Cross-examined by SIR EDWARD CLARKE, WITNESS admitted that the corporation would have 50 per cent. more water than they had at the present time.

SIR ALEX. KENNEDY, re-examined by MR BROWNE, said that the arrest of the condensing work was solely due to the requests of the L.C.C.

Addressing the tribunal on the water question, MR. BALFOUR BROWNE, said that the offer the L.C.C. made was clearly not in compliance with the section of the Act because it did not give them water at all. The L.C.C. had only provided a subway which was only a link in the chain, and only one-half of what was required. What he desired the tribunal to give him was equal facilities.

SIR EDWARD CLARKE said that they had succeeded in clearing up what might have been a very difficult question for the tribunal to settle, and might have involved the services of an expert. The Council had either to provide the Corporation with equal facilities to those they have in Millbank for obtaining water whether such facilities were actually used or not. Seeing the four 16-in. pipes were never laid, he held that the £3,100 claimed, ought not to be allowed, while he also claimed that a deduction should be made for the 50 per cent. extra water which the Corporation were to be in possession of through the means of the four 20-in. pipes.

SIR ALEX. KENNEDY then gave evidence regarding the buildings from an engineering point of view. He said that the total floor area of Millbank works was 32,546 sq. ft. and at Horseferry 40,914, the ratio between them being 79½ per cent. He considered they had a right to ask the L.C.C. to pay for the new station to the extent of 77 per cent. of their actual expenditure.

MR. EDWARD A. GRUNING, architect, examined for the Corporation, said he supported Mr. Peache's figures; the County Council should be called upon to pay seven-tenths of the cost of the erection of the building.

SIR ALEX. KENNEDY was subsequently examined by MR. LYTTLETON regarding the plant required for the new premises. He pointed out that the capacity of the new plant in kilowatts should be equal to the capacity in kilowatts at their present station. He strongly held that the section of the Act could not mean output in units, because there was no such thing as output at a specific time. Output could only be calculated over a period; therefore the Act clearly meant capacity at the time of removal. The capacity of the Corporation's steam plant at the existing station was 2,536 KW. and 2,890 KW. of motor-generating plant—a total of 5,426 KW. The corporation had obtained tenders for plant for the new premises as follows: Condensing plant, £61,443, and motor-generating plant, £23,131, giving a total of £84,574. The plant was more complete, modern and economical, and cost much less than the type at the existing premises, and if the corporation had copied their present plant, they would have required to ask the L.C.C. for more money than they are now doing. If they did not get the new machinery they desired, and had to install plant of the same type as they now had, then he would ask an additional sum of £7,000.

Cross-examined by SIR EDWARD CLARKE, WITNESS said that the new plant would possibly occupy two-thirds of the space as compared with that occupied by the Millbank machinery. Sir Alex. Kennedy would not agree to a suggestion of Sir Edward Clarke that, seeing they only required two-thirds space, the corporation did not require so large a building.

Re-examined, SIR ALEX. KENNEDY said that the alterations to the mains for the supply to the district was a very serious matter. They had got to distribute current at some 14 or 15 points at a certain pressure which was fixed by statute, and accordingly they required a higher pressure at the station. Consequently, there was a big loss of pressure between the switchboards and the feeding points. The actual loss for the past few years was as follows:—1905 6, 26·5 volts; 1906-7, 27·2 volts; and 1907-8, 28·5 volts. On an average the corporation had lost 28 volts.

On Saturday SIR ALEX. KENNEDY was examined regarding the drop in the voltage between the station and the feeding points, and he said he had made arrangements whereby the drop at the new works would not be greater than 28 volts. This was to be carried out by using additional copper. The corporation had received a tender from Callender's Cable Co. for the relaying of mains, pipes, excavation, copper, lead, &c., at £46,753. Besides that total there had to be added £2,337 for engineers' charges, £4,675 for contingencies, and £250 for alterations to high-tension mains. These four items gave a total of £54,015, the sum for which they claimed. When they changed to their new premises all the feeders except two would be longer, and therefore the corporation would have to put in a larger amount of copper to keep the loss of volts the same as at present.

Cross-examined by SIR EDWARD CLARKE on the £46,753 for the electric mains, SIR ALEX. KENNEDY admitted that if the Corporation had remained at their Millbank premises, they would have required to lay down extra mains, and would have had to bear the expense themselves. Witness never considered the point that there ought to be a reduction of the claim in view of that fact. The cost of the condensers at Millbank was £3,870. Sir Edward Clarke asked why it was that the batteries were to cost some £4,000, when he understood the old ones only cost between £1,600 and £1,700. Sir Alex. Kennedy said he did not exactly know what constituted the old battery, and what the £1,700 included. Their new battery was up-to-date, and far in advance of the old one.

In re-examination, WITNESS stated with regard to Sir Edward Clarke's contention that a deduction should be made for the laying of mains, that the contract was made for 1909-10, and the corporation would only get reinstated for the then existing mains. The proceedings were adjourned.

LILLICO *v.* SOUTH SHIELDS CORPORATION.

AT South Shields County Court on the 12th inst., John George Lillico sued the South Shields Corporation for £50 damages for personal injuries received through having been knocked down by a tramcar in Fowler Street on June 7th. Mr. T. W. D. Spence was for the plaintiff, and Mr. E. Meynell was for the Corporation.

MR. J. G. LILLICO said that on June 7th he was going home, and had stepped into the middle of Fowler Street, when he noticed a tramcar going towards Westoe. The driver rang his bell, and plaintiff stepped back. He then noticed that another car going in an opposite direction was close upon him, and before he could get out of the way he was knocked down and dragged 50 yards. He was rendered unconscious, and was ill about a fortnight.

In answer to MR. MEYNELL, WITNESS said that he did not look to see if the car which knocked him down was approaching.

Other evidence was given for the plaintiff, after which his Honour, Judge O'CONNOR, without calling upon the defence, said there was no question of any negligence on the part of the defendants' servants. The man apparently walked into the middle of the road without looking to see if there was a car going down. He must find for the defendants, with costs.—Judgment was entered accordingly.

EALING TOWN COUNCIL *v.* LIPTON, LTD.

AT Brentford County Court on Friday, before his Honour Judge Howland Roberts, plaintiffs sued defendants for £58 for electric light supplied to their Ealing branch establishment. Mr. Brydges, the town clerk of Ealing, was for the plaintiffs, and Mr. Baron for the defendants.

The former stated that the defendants had a shop in Ealing Broadway. It formed part of the premises known as the Ealing Hippodrome, in fact, a portion of the original restaurant had been let to the defendants. The light was supplied to them, but they claimed they were responsible to the Hippodrome company under their agreement.

MR. BARON disputed the right of the Court to hear the summons. In 1906 the Hippodrome company let the premises to the defendants under an agreement, by which the defendants were supplied with electric current by the proprietors of the hall. Before the Justices the plaintiffs took proceedings for penalties against the management of the Hippodrome for supplying electric current without having the statutory power to do so, and the Bench held that there had been an infringement of the provisions of the Electric Lighting Acts, and ordered payment of the costs. Against that decision the Hippodrome management were appealing by way of case stated, and the case would be argued about the month of December. The whole point turned upon the construction of the agreement, and upon the decision of the Divisional Court the judgment in the present action would depend. Under such circumstances, it would be in the interest of all parties that his Honour should stay these proceedings until after the decision in the higher Court.

His HONOUR said that if he proceeded to try the case, it might be possible that one side or the other would go to appeal. There was already an appeal pending with regard to this matter, and it would be unwise to run the risk of having two before the superior Court at one time. He should therefore adjourn the hearing.

CAMPBELL & ISHERWOOD, LTD., *v.* GALE SHIPPING CO.

AT the Liverpool County Court on Wednesday last week, before his Honour Judge Shand, defendants, owners of the ss. *Storm*, were sued by plaintiffs, electrical engineers, of Bootle, for £7 6s. for overhauling and repairs to the electrical installation on board the steamer.

COUNSEL for plaintiffs stated that his clients made the installation under a contract, but before the actual completion of the work the vessel had to go to Preston to receive her dynamo. She sustained damage in a collision on the return journey, and when plaintiffs went to complete and test the installation, they found the switchboard was damaged, and this and other repairs were necessary. The chief engineer was informed that all this was extra to the contract, and it was contended that he gave them instructions to do the work, which they did; but on presentation of the account defendants repudiated liability and denied the instructions.

Plaintiffs' case was that the damage was not due to the collision, but was probably caused by other workmen.

For the defence, Capt. Joseph Gale declared that the chief engineer had no authority to order the repairs, and that the plaintiff firm might easily have referred to him (witness) for instructions, as he was aboard the ship every day the work was in progress.

Chief-Engineer E. Lancaster denied that he ordered the work, and disclaimed having the necessary authority to do so.

His Honour remarked that if a chief engineer was allowed to repair what he liked in the way of stores or repairs, he might put the owners to enormous expense. "I am afraid," he added, "that even on this ship (the Court) in which we now are, if we want an extra light we can't have it without going to the Board of Works for it." The Judge held that most of the work claimed was part of plaintiffs' contract, and that no order was given by the chief engineer or anyone who would bind the defendants, for whom he gave judgment, with costs.

Oppenheim *v.* Harrods, Ltd.

Conflicting evidence as to the part a "nipple" plays in securing a pendant electrolier, was the turning point in a claim made in Brompton County Court on Friday. Mr. Ludwig Hendrich Oppenheim, of 29, Gledhow Gardens, Kensington, was suing Harrods, Ltd., for £38 10s., the price of an elaborate chandelier, which he averred was destroyed through the negligence of the defendants' workmen. The chandelier was one of a pair which had been converted from gas to electricity by Oslers, Ltd., in 1903, and it appeared that the "nipple" which linked the pendant to the drop pipe by an even-thread screw was not supplemented by a graduated-thread nipple, so that it could not swing round when fitted with the electric wires. Messrs. Harrods' workmen were cleaning these ornamental lights, when one of them, without warning, fell with a crash to the floor of the drawing room and was completely smashed. It was alleged that the man who was cleaning the crystal pendants, flicked them with a cloth and swung the pendant round in such a way that the nipple became unscrewed, and hence the chandelier fell. Mr. W. R. Rawlings (of Rawlings Bros., Ltd.), Mr. F. B. Marshall (Electrical Fittings, Ltd.), Mr. Howard (Heath) gave evidence for the plaintiff, and Mr. James Temple, Mr. Ellwood (Benson's, Ltd.), Mr. Josl (Defries, Ltd.), and others, gave evidence as to the part the "nipple" played in securing the pendant, and the trial was adjourned.

Chester Corporation *v.* Evans.

At Chester on 11th inst., William Samuel Evans was charged before the magistrates with fraudulently obtaining electricity from the Corporation. Defendant is a hairdresser, and the case for the Corporation was that the defendant had used for lighting purposes the cheap power current supplied for the electric fan, thus effecting a saving of £12. Defendant pleaded that, not having a knowledge of electricity, he had been misled by the man who had fitted his new lamps. The Bench imposed a penalty of £20 and costs.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

23,294. "Improvements in or relating to dynamo-electric machines." Mather & Platt, Ltd., A. C. Coubrough and C. Mather, Jun. November 2nd.

23,301. "Improved system of overhead electric wires for electric propulsion on roads and canals and an improved trolley-arm for use in said system." R. P. Dodd, E. Dodd and W. J. Kershaw. November 2nd.

23,328. "Improved means of transport for portable electrically-driven pumps for fire brigade or for other purposes." W. A. Stevens. November 2nd.

23,340. "Improvements in and relating to the detection of faults in overhead lines for high-tension alternating electric currents." Siemens Bros. Dynamo Works, Ltd., and F. Lydall. November 2nd. (Complete.)

23,341. "Improvements in and relating to the mechanical operation of electric-motor controllers." Siemens Bros. Dynamo Works, Ltd., and F. O. Thompson. November 2nd.

23,362. "Improvement in carbon brush holders." The firm Robert Bosch. (Application for Patent of Addition to No. 21,568/08.) November 2nd. (Complete.)

23,392. "Improvements in switch contacts." British Thomson-Houston Co., Ltd., and E. B. Wedmore. November 2nd. (Complete.)

23,396. "Improvements in the generation of electrical power and speed regulation in electrical propulsion of ships, railway, tramway, or other road or similar vehicles, locomotives, trains and the like." W. P. Durtnall. November 2nd.

23,413. "Improvements in electrical conductors and fittings." A. E. Lamkin and T. R. Nunwick. November 3rd.

23,423. "Improvements relating to electrical switches." F. B. Lodge and A. M. Lodge (trading as Lodge Bros. & Co.). November 3rd.

23,496. "Improved method of and apparatus for signalling by electricity." W. Popow. November 3rd. (Complete.)

23,456. "Improvements in or relating to electric torches, gas lighters, lamps, and the like." Co-operative Wholesale Society, Ltd., and J. Clarke. November 3rd.

23,477. "Improvements in electric wire fittings." J. Marshall. November 3rd.

23,489. "Improvements in high potential rectifying switch." H. C. Spoor. (Date applied for under Sec. 91 of the Act, July 20th, 1907, being date of application in United States. An invention comprised in Application No. 13,754, dated June 30th, 1908.) November 3rd. (Complete.)

23,490. "Improvements relating to telephone exchanges." M. F. G. Boddington. November 3rd.

23,508. "Improved unwarpable mounting for process engravers, electrotypers, and the like." A. E. Dent. November 3rd.

23,515. "Improvements in and relating to switch arrangements." M. B. Field and Ferranti, Ltd. November 3rd.

23,546. "Improvements relating to electrically-operated tramway or like points." G. H. Butterworth and E. Veevers. November 4th.

23,570. "Improvements in wireless facsimile telegraphs." H. Knudsen. November 4th.

23,572. "New or improved interruptor or conducting wheel for use in connection with electrical apparatus." C. Ruzicka, R. M. Scott and C. H. Ivinson. November 4th.

23,575. "Improvements in and relating to section insulators for overhead trolley tramway equipment." W. Wood. November 4th.

23,590. "Improvements in or relating to telephonic installations." M. Baumer. November 4th. (Complete.)

23,602. "Improvements relating to controlling devices for electric motors." F. D. Hallock. (Date applied for under Sec. 91 of the Act, November 8th, 1907, being date of application in United States.) November 4th. (Complete.)

23,613. "New or improved magnatic toy or puzzle." H. R. Parton. November 4th.

23,615. "Re-perforating instrument for use in telegraphy." J. Gell. November 4th. (Complete.)

23,622. "Dry rezincable galvanic cell." F. Weatherill. November 5th.

23,623. "Telephone call record." G. M. Benington. November 5th.

23,677. "Improvements in or relating to electric brakes or interrupters." E. E. Greville. November 5th.

23,703. "Improvements in insulators for electric wires or cables." W. Copeland. November 5th.

23,704. "Improved construction of electrical resistance devices." H. S. Martin. November 5th.

23,709. "Improvements in brush gear for dynamo-electric machinery." P. L. R. Fraser and The Tudor Accumulator Co., Ltd. November 5th.

23,711. "Improvements relating to electric ignition apparatus for internal combustion engines." J. H. Chambers and Thomson-Bennett, Ltd. November 5th.

23,726. "Improvements in the manufacture of filaments for incandescent electric lamps." British Thomson-Houston Co., Ltd., and H. H. Needham. November 5th.

23,727. "Improvements in and relating to signalling systems for railways and the like." (Date applied for under Rule 13, October 14th, 1908. An invention comprised in application No. 21,766, dated October 14th, 1908. Application for Patent of Addition to No. 20,542, 1906.) British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 5th.

23,736. "Improvements in trolley heads for electric tramway cars and the like." A. Sullivan and E. C. Stewart. November 5th.

23,739. "Improvements in the winding and disposing of the secondary circuits of induction coils used with telephone apparatus." R. R. Harper. November 6th.

23,800. "Improved method for coupling dynamos and electric motors." A. H. Zumsteg and R. E. Zumsteg. November 6th. (Complete.)

23,807. "Improvements in and relating to switchboards." H. Stotz. November 6th. (Complete.)

23,834. "Improvements in or relating to telegraphic apparatus." F. G. Creed and W. A. Coulson. November 6th. (Complete.)

23,854. "Improvements in or relating to brakes of electrically-operated tramcars and the like." R. Hacking and H. W. Hill. November 7th.

23,870. "Improved variable electric voltage regulator." T. McClelland, jun. November 7th.

23,879. "Hydro-electro-pneumatic governor for marine engines." G. L. A. Paris. (Date applied for under Sec. 91 of the Act, November 9th, 1907, being date of application in France.) November 7th. (Complete.)

23,888. "Connections for automatic telephone with circular transmission." P. Hilderbrand. November 7th.

23,893. "Improvements in sparking plugs." G. H. Anger. (W. E. Anger, United States.) November 7th.

23,894. "Improvements in or relating to metallic frictional blocks, such as brake blocks, electrical collector slippers and the like." T. Ashmore and P. McCullough. November 7th. (Application for Patent of Addition to No. 8,344/1905.)

23,906. "Improvements in electrical apparatus for working planing machines and other reciprocating tools." Vickers, Sons & Maxim, Ltd., and A. D. Williamson. November 7th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1907.

Electric Ships' Logs. E. V. H. Rizzo. 22,473. October 11th.

Dynamos Carried by Motor Cars, Vessels or like Moving Bodies. A. Moodie. 22,572. October 14th.

Transmission of Telephonic Currents and Undulatory Electric Currents in General. W. F. Gradolph and W. C. Hahne. 22,757. October 15th.

Apparatus for the Electric Lighting of Railway Carriages. E. M. Preston and A. E. Kennard. 22,756. October 15th.

Galvanic Cells. M. Kaliss. 22,860. October 16th.

Fuse-Controlled Electrical Apparatus. A. F. Berry. 23,188. October 19th.

Electric Arc Lamps. Johnson & Phillips, Ltd., and C. F. Tubbs. 23,148. October 19th.

Means for Obtaining Motive Power from Single-Phase Circuits. V. A. Fynn. 23,224. October 21st.

Electrical Connection Devices. O. Graetzer. 23,774. October 28th.

Electric Controlling Devices. British Thomson-Houston Co. (General Electric Co., United States.) 23,914. October 30th.

Electric Switches or Switch Operating Devices. G. Gaglio and L. Villani. 24,200. November 1st.

Electric Bells. G. W. Mascord and T. A. E. Blake. 24,294. November 2nd.

Raising and Lowering of Arc Lamps and the like. A. Wunderlich and G. A. Hughes. 25,398. November 15th.

Telephone Systems. A. A. Monson. 26,251. November 21st. (Date applied for under International Convention, November 27th, 1906.)

Telegraphic Code Condensers. Nobel's Explosives Co. and M. B. Dickie. 27,0.0. December 6th.

Contacting Device for Electrical Measuring and Indicating Instruments. J. Y. Johnson. (Firm of W. C. Heraeus, Germany.) 27,298. December 10th

Electric Circuit-Breakers. E. N. Bray and Bray, Markham & Reiss, Ltd. 28,289. December 23rd.

Electrical Overload Indicators. T. Harrison. 28,507. December 27th.